

Irondale Iron and Steel Plant
Port Townsend vicinity
Jefferson County
Washington

HAER No. WA-7

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WASH,
14-PORTO.V,
1-

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Historic American Engineering Record
Western Region
National Park Service
Department of the Interior
San Francisco, California 94102

HISTORIC AMERICAN ENGINEERING RECORD

HAER
WASH,
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Irondale Iron and Steel Plant

HAER No. WA-7

Location: Ten miles south of Port Townsend on the western shore
of Port Townsend Bay

Quad Name: Port Townsend South

Date of Construction: 1881; demolished 1919

Present Owner: Cotton Engineering and Shipbuilding Corporation
P. O. Box 111
Hadlock, Washington 98339

Present Use: Vacant

Significance: First established in 1881, Irondale is significant as
the site of one of the first attempts to introduce
heavy industry into western Washington, and was
notable as an efficient and modern manufacturing
facility.

Report Assembled by: Diane and J. D. Britton
Washington State Office of Archeology
and Historic Preservation
Olympia, Washington

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INTRODUCTION

The Irondale iron and steel plant is an historical/archaeological site in Jefferson County, Washington, on the northeast corner of the Olympic Peninsula. Crumbling brick and concrete foundations, now hidden by blackberry bushes and maple and alder trees, are all that remain of the plant (photos 1-19). The townsite of Irondale is located ten miles south of Port Townsend and 38 miles northwest of Seattle. Presently a quiet residential area, the central business district no longer exists. A bustling industrial center in its heyday, Irondale boasted an active commercial hub with daily steamer traffic arriving and departing from its dock.

The first blast furnace opened in 1881 after the discovery of a nearby iron ore deposit. The iron plant closed in 1889, marking the end of Irondale's first industrial era. Ambitious promoters put the operation into production again, eventually adding the first plant west of Colorado to produce steel from its own raw materials.

Based on the cost of importing iron and steel from the East, investors recognized the high profit potential of founding an industry in the Puget Sound area. However, prohibitive fuel prices and imported iron ore from British Columbia and China kept expenses high. In addition, owners raised an insufficient amount of capital to maintain operations within the confines of modern improvements. Despite Irondale's failure and final shutdown in 1919, the plant is significant as one of the first attempts to introduce heavy industry into western Washington. It drew eastern attention and population to the area, but in true boom town tradition, Irondale and its industry prospered and declined together.

INITIATION OF IRONDALE'S INDUSTRY

An iron-making industry started in Washington Territory when James Jones, E.L. Canby, H.L. Blanchard, and Samuel Hadlock together incorporated the Puget Sound Iron Company in Jefferson County in 1879.¹ The company expected to use a local hematite ore from a deposit in the Chimacum Valley located four miles south of Port Townsend to manufacture pig iron. A series of agreements made with landowners William Bishop, William Eldredge, Olaff Peterson, and John Lindley obligated the officers of the Puget Sound Iron Company to build a blast furnace and wharf near the head of Port Townsend Bay in Jefferson County in return for the right to mine the ore on their land and 25 cents per ton royalties. In addition, the officers promised that none of the ore would leave the county except as finished pig iron.²

The people of eastern Jefferson County, as well as Washington Territory, viewed the discovery of bog ore and subsequent formation of the Puget Sound Iron Company as a boon to their economy. The Washington Standard of Olympia reflected a mood of optimism when it reported that the man who discovered iron ore benefited not only the territory, but also assured his own fortune, more so than a find of gold or silver bearing minerals. Furthermore, in another article, a reporter described the Chimacum deposits as "inexhaustible."³ However, a sign of foreboding appeared in an editorial letter published by the Puget Sound Weekly Argus. It warned that a blast furnace at Irondale did not necessarily mean prosperity. According to the writer, a successful iron industry required skilled workers drawing large salaries, a readily available market, a nearby population base, sufficient capital for further investment, and iron produced cheaply enough to compete with eastern products.⁴ During the next forty years, Irondale took on many characteristics of a boom town as the iron industry alternately prospered and declined.

Construction of Irondale's first blast furnace, laying out the townsite, and establishment of several businesses including a hotel commenced and continued through the fall of 1880. Company workers built the 38-foot cone-shaped structure from large pebbles found on the beach, completing it early the next year. The furnace possessed a capacity to produce four thousand tons of pig iron annually. Employees of the Puget Sound Iron Company blew the furnace in on January 27, 1881, and then dumped a charge of Chimacum bog ore, charcoal for fuel, and limestone as flux, into the top of the stack. Every eight hours the workers tapped molten iron, freed of impurities, and allowed it to flow into adjacent sand molds called "pigs" and "sows." Another spout channeled slag away from the finished product to be discarded as waste (photo 26; also see Appendix I).⁵

In 1881, the Puget Sound Iron Company leased several iron ore mines on Texada Island, British Columbia, for \$30,000 and bought them outright in less than five years. This hard magnetic ore, when combined with soft chimacum bog ore, produced a high quality pig iron. Limestone, a mineral used to attract impurities, arrived from San Juan and Orcas Islands. B.S. Miller, a local entrepreneur, employed about 70 men at nearby charcoal pits to supply the furnace with sufficient fuel. The Puget Sound owners estimated that a successful iron smelting operation required 912 cords of fir wood a day.⁶

The first blast furnace produced pig iron on a routine basis until March 1881, when the firebrick lining melted causing a temporary shutdown.⁷ Irondale's industry was continually plagued with various problems causing similar closures throughout its history. Regardless of the setback, improvements to the iron plant and town progressed at a rapid rate. By May, the wharf extended far enough into Port Townsend Bay to accommodate ocean steamers. Installation of a roasting furnace and crushing machine allowed the plant to

run more efficiently. A company store opened early in the summer to supply needed goods to Irondale residents. About the same time, a local paper reported an offer by Puget Sound Iron Company for "liberal inducements" to those desiring to start related manufacturing enterprises or businesses in the area.⁸

At the end of the year the old stone furnace was torn down after producing 1,200 tons of pig iron, and replaced by a new steel plated model with a daily capacity of 50 tons. Construction proceeded throughout 1882, preventing the manufacture of pig iron that year.⁹ On April 21, 1882, the newly formed Puget Sound Iron Company of California paid the Puget Sound Iron Company of Washington Territory \$500,000 for the iron plant including 14½ acres of land on Port Townsend Bay, all structures, machinery, and mining rights at Chimacum Valley and Texada Island.¹⁰ However, the new owners experienced similar problems despite the completely rebuilt furnace. The refractory nature, or high melting point, of the Texada ore required such intense heat that the blast furnace's firebrick lining melted. Late in 1883, the hearth burned out, once again resulting in closure for repairs. The second furnace, in operation for only a part of 1883, produced a total of 2,317 tons of pig iron.¹¹

During 1884, a work force remodeled the iron plant, updating it with modern improvements. The 50-foot furnace, originally open at the top, was sealed by a bell and hopper to prevent carbon monoxide gases from escaping. A passageway called a downcomer channeled this combustible element under the hot stove and boiler where it burned as fuel. A new stove, boilers, and blowing engine worked in unison to provide a hot blast to the furnace (photo 23). The company also built 20 charcoal kilns at a cost of \$42,000 to alleviate the unprofitable problem of hiring private parties to supply fuel. The

kilns, built of brick hound with wrought iron and plastered over with concrete, each measured 30 feet high, 30 feet at the base, and held 75 cords of wood (photo 24). Although the company spent most of 1884 renovating the plant, it still managed to produce 540 tons of pig iron.¹²

Between 1885 and 1888, despite various shutdowns, the Irondale blast furnace smelted an average of just under 3,000 tons of pig iron annually.¹³ The locality of the plant ostensibly combined the advantages of "cheap ore, cheap fuel, cheap limestone, and cheap transportation." Billed as "the seat of iron making in Puget Sound," newspaper hyperbole expounded on the many virtues of the young town and iron plant. Also by the mid-1880's, several accounts reported Puget Sound Iron Company's plan to expand into steel making.¹⁴ However, since the company never committed itself to that proposition, the conjecture simply reflected wishful thinking.

During 1889, the plant turned out 10,371 tons of pig iron.¹⁵ By this time the company employed over 400 men in mining, making charcoal, and smelting up to 40 tons of iron a day. The product's high quality accounted for its demand at the Union Iron Works in San Francisco, which used some of this iron in construction of the cruisers "Charleston" and "San Francisco," and the battleship "Oregon." Ironically, after its highest annual production to date, the plant closed and remained dormant for the next 11 years.¹⁶

No single reason explains the 1889 closure. The use of crude and unprofitable machinery, a lack of competent supervision, and apathetic stockholders contributed to the company's failure. The distance between the San Francisco owners and the daily iron-making decisions at Irondale created disinterest in the operation of the plant. Furthermore, high labor costs, an import duty on Texada ore, and the use of charcoal as fuel made the smelting process very expensive. Although charcoal produced a superior quality pig

iron, its exorbitant cost and the volume needed in the blast furnace became too prohibitory for the Puget Sound Iron Company to survive. Coke, another good fuel source, did not become available to Washington iron producers until the twentieth century.¹⁷

Although an industry dominated by eastern interests, westerners recognized the potential of iron-making from the time of their earliest settlement. In 1851, Mormon pioneers erected a blast furnace at Cedar City in Iron County, Utah, where they produced the first pig iron west of the Missouri River. This plant continued for seven years until financial and technical difficulties caused its closure. Another attempt in Iron County by the Western Iron Manufacturing Company lasted ten years, but financial failure forced it to shut down in 1873. The Oregon Iron Company in operation at Oswego, near Portland, began iron production in 1867. Over the next 27 years, its furnace experienced a series of owners, remodelings, and shutdowns until closing for good in 1894 after a total output of 93,404 tons of pig iron. To the south, the California Iron Company maintained a blast furnace at Clipper Gap between 1881 and 1886 and produced 14,635 tons of pig iron. High priced raw materials and poor management caused these ventures to suffer fates similar to that of the Irondale plant. Nevertheless, the era of the iron industry on the West Coast was far from over.¹⁸

DREAMS OF AN INDUSTRIAL EMPIRE

Rumors concerning the possible sale and restoration of the Irondale plant began circulating in 1900 when Homer H. Swaney, a lawyer from McKeesport, Pennsylvania, sent eastern iron-making experts to examine the Puget Sound Iron Company properties. J.H. Cremer of the Wellman-Seaver Engineering Company of Cleveland, Ohio, studied the technical problems of rehabilitating

the blast furnace and auxiliary equipment and submitted his report to Swaney. According to Cremer's analysis, implementation of successful pig iron production necessitated an expenditure of only \$25,000 for repairs and improvements.¹⁹

Based on this favorable examination, Swaney organized the Pacific Steel Company in 1901 with eastern capital and bought the iron plant for \$40,000. The company put approximately \$60,000 into general repairs and the construction of a new hot stove and boiler. Furnace improvements included relining the 50-foot stack with a two-foot thickness of firebrick and installing water cooled iron plates within the hearth and bosh area to protect them from melting (photos 23 and 25).²⁰ Restoration continued throughout the spring, employing up to 150 workers imported from McKeesport because of their first-hand knowledge of the iron-making process. Henry Hall of Wellman-Seaver directed this repair work as well as the construction of a new laboratory for iron testing. Frederick Crabtree, also of McKeesport, joined Pacific Steel to take charge of the Irondale furnace.²¹

In July, workmen started fires under the kilns to provide a large supply of charcoal before blowing in the furnace. However, hoping to ultimately offset the high cost of production, Swaney invested \$6,000 for improvements and additions to the Irondale charcoal plant (photo 24). Company employees erected a sawmill, log splitting machine, and conveyor system to automatically feed wood into the kilns. As a result, the efficiency of charcoal production increased while its cost dropped substantially.²²

In the meantime, Swaney acquired iron and other mineral properties large enough "to develop the iron industry to an enormous extent." Shipments of ore from Texada Island and Hamilton in Skagit County began in the fall of 1901 after Pacific Steel obtained leases to the claim deposits. Limestone

arrived from Roche Harbor in the San Juan Islands.²³ About the same time, iron deposits found in the Olympic Mountains prompted discoverers to claim that enough ore existed "to keep a half dozen smelters operating for an indefinite period." The possibility served to further boost the economic potential of the area.²⁴

Local papers, reflecting an optimistic attitude, reported the return of "an air of prosperity." The town of Irondale, located on 300 acres of Pacific Steel property, grew with the iron plant (photo 20). New construction included a row of company officer's houses, a hotel, 19 cottages for employees and their families, bunk and boarding houses for single men, and several new businesses. In April, Swaney applied for the establishment of a post office to facilitate communication. Telephone and telegraph lines built between Irondale and Port Townsend gave the new town an air of permanency. The Seattle Post-Intelligencer reported Irondale's success as a "complete business revolution on the Pacific Coast."²⁵

Swaney finally realized his ambitions on December 15, 1901, when his wife ceremoniously lit the Irondale furnace for the first time in twelve years. After blowing in, a "dense volume of black smoke shot out of the big flue, followed by a red blaze," a welcome sight.²⁶ Although less dependent on simple manpower, the operational procedure was similar to that of the Puget Sound Iron Company. A large steam derrick unloaded imported ore from scows and dumped it into bunkers on the pier. From the bunkers, a small locomotive hauled ore-filled cars to an area near the elevator to be roasted and crushed. Workers weighed specific amounts of ore, limestone, and charcoal, and hoisted the mixture to the top of the elevator. Deposited in carts on the bridge, employees wheeled the raw materials across the 50-foot span and dumped them into the top of the blast furnace. Once inside, the iron ore

gradually melted at a temperature of 3500 degrees and dripped down to the hearth. Workers tapped the furnace once every eight hours to allow the pig iron to run off into sand molds (photo 21, see also Appendix 1).²⁷

Pacific Steel, from its remodeled plant at Irondale, produced 50 tons of high quality pig iron a day. No other blast furnace operated on the Pacific Coast at this time. Foundries and machine shops from Alaska to southern California used Irondale's product. The Irondale plant employed directly and indirectly about 300 men--100 at the smelter, 100 in the mines, and 100 felling trees. These workers manufactured 6,000 tons of pig iron before the plant closed in January 1903. Swaney considered this first run an experiment and concluded it a success. Consequently, he continued to buy raw material deposits and drew up ambitious plans to expand into steel production.²⁸

Pacific Steel Company officers and a number of Seattle investors formed the Seattle Iron and Steel Company in March 1903 with a capital stock of \$6 million. Swaney, as president, planned to expand Irondale's blast furnace operation to supply a proposed steel plant and mill in West Seattle. The company hoped the low cost of ore in the Pacific Northwest would make its products competitive with eastern mills. A large work force of skilled laborers "anxious to get away from plants controlled by the steel trust," was believed to be available for both operations.²⁹

Expansion of the Irondale plant began in August 1903, and Swaney continued to formulate his grandiose plans for a gigantic iron and steel industry despite financial troubles. He secured a site on the waterfront in West Seattle for open hearths and rolling mills, and acquired a schooner to carry pig iron from Irondale to the new plant.³⁰ All activities of both companies ceased, however, when Swaney unexpectedly drowned on January 9, 1904, in the wreck of the steamer "Clallam." It capsized in the Strait of Juan de Fuca

during a storm. Within a week, a federal judge named Pacific Steel Company's secretary, M.J. Carrigan, as receiver of the now idle Irondale operation.³¹

The Pacific Steel Company was in deep financial trouble before Swaney's death. Swaney spent most of his time building an iron and steel monopoly, but left "the blast furnace with little or no attention." The Irondale furnace produced no pig iron during 1903, and yet Swaney continued to buy raw material deposits and plan for a Pacific Coast steel industry. Furthermore, the Irondale plant experienced "continual shut-downs owing to shortage of fuel, breakdowns of the hot-blast stove, and other difficulties which could have been avoided with sufficient capital."³² With the passing of Pacific Steel, Irondale again lay dormant; however, another company would yet breathe life into a Pacific Coast iron industry.

RESTORATION OF IRON MAKING

On September 7, 1906, James A. Moore, a Seattle capitalist and owner of a large investment company, bought the Irondale property at a receiver's auction. No opposition appeared against Moore's \$40,000 bid, the minimum price set by the Court. The property encompassed 320 acres on Port Townsend Bay with a half mile of water frontage covered by 31 residential and business buildings, the furnace, and factory structures (photo 20).³³ Moore first visited the Irondale plant in January 1902 when the Pacific Steel Company produced pig iron and realized the potential of an iron and steel industry in the Pacific Northwest.³⁴

Moore immediately announced plans to spend \$100,000 to increase the blast furnace's daily capacity, add up-to-date machinery, and completely rehabilitate the property. He proposed to solve the historic problem of expensive fuel by installing a plant to manufacture timber by-products and use the

profit to pay for charcoal production. An ambitious man with great dreams, Moore anticipated opening the Irondale furnace within six months.³⁵ Once again, the future of the area looked bright.

Moore originally planned Irondale as an auxiliary to a proposed steel rolling mill operation at Kirkland, Washington. However, the "mammoth works" fell through and Moore concentrated his efforts on reopening the Irondale plant under the Irondale Furnace Company, incorporated on November 6, 1906.³⁶ During the following spring, the company hired 60 workers to rebuild the plant and prepare the furnace for blowing in. William Price, general manager for the new Irondale company, traveled to the East and ordered necessary machinery for the plant; but labor strikes delayed the equipment's delivery until May. Meanwhile, Irondale laborers enlarged the blast furnace to 60 feet and built a new hot stove as soon as its parts arrived. Moore now planned to complete the plant's renovation and begin smelting in early 1907.³⁷

Unable to hire a sufficient number of laborers in the Port Townsend and Irondale areas, Moore brought 40 men over from Seattle to work on the iron plant. Local residents seemed skeptical about committing themselves to the iron industry after two previous failures. Also, some of the eastern employees brought to Irondale under Swaney most likely left the area when Pacific Steel went into receivership. However, 40 additional laborers did not satisfy Moore's needs, consequently he "turned to the Japanese labor contractors" in Port Townsend and hired "a large delegation." To maintain peace between workers, foremen gave white employees "the cleaner work" while the Japanese were "turned loose where the dirt and grime" was thickest.³⁸

Early in 1907, Moore arranged for the shipment of ore from mines on Quatsino Sound, Vancouver Island, by the San Francisco based Dollar Steamship

line. Later that spring, the Irondale Furnace Company leased the iron mine on Texada Island and purchased bog ore from Skagit County, Washington. The company also bought two large scows and a barge for \$30,000 to transport the ore to Irondale.³⁹ Moore, confident of his success with the Irondale operation, later said "one of our iron deposits in British Columbia alone is capable of supplying our furnace for one hundred years." Furthermore, he would be "greatly disappointed" if the future did not "see the Irondale furnace turning out from 400 to 500 tons a day."⁴⁰

The repair crew finished relining the blast furnace in July 1907, and lit drying fires to prepare it for the first charge. A series of unexplained explosions inside the furnace, however, delayed the plant's opening. Workers again repaired the furnace; but another explosion occurred "which killed one employee and injured several more." An exasperated Moore halted any further work and the plant remained idle until a crew of "experts" arrived from Pennsylvania in September to supervise the furnace's restoration. Production finally began in October and the Irondale Furnace Company manufactured a high grade of pig iron.⁴¹

Near the end of the year, an insufficient supply of charcoal forced the company to blow out the blast furnace. Despite the high cost of fuel, nearly double that of imported iron ore, Moore's plans for a by-products plant never materialized. In order to solve the crisis, the company ordered 6,000 tons of coke from British Columbia, but the plant remained closed through the rest of 1907. Nor did Irondale produce any pig iron in 1908. Besides the fuel problem, a financial depression reduced market demand. Even though the Irondale Furnace Company realized little or no profit during this period, it continued to make improvements and maintain the plant.⁴²

FOUNDATION OF IRONDALE'S STEEL INDUSTRY

In December 1907, Moore returned from a trip to the East and announced the formation of a new million dollar corporation composed of eastern capitalists. On January 14, 1908, the Irondale Steel Company incorporated to take over the Irondale Furnace Company's property and holdings.⁴³ Moore arranged for the sale of \$500,000 in bonds to erect open hearth furnaces and rolling mills for "the first complete steel plant erected west of the Rocky Mountains." A number of steel production plants, previously organized in Oregon and California, manufactured steel solely from iron and steel scrap.⁴⁴ Moore proposed to produce steel from pig iron smelted in the Irondale blast furnace and scrap acquired from the Pacific Coast region. He claimed that steel magnates from New York and Pennsylvania promised to come forward with \$10 million for expansion after a successful demonstration.⁴⁵

Moore, wasting little time, placed an order with the Moran Brothers Company of Seattle for the construction of a steel plant "in the shape of an open hearth furnace." Meanwhile, the Irondale Steel Company gained a reputation with nation-wide publicity. The Wall Street Journal reported the company's acquisition of "the only blast furnace in the state of Washington" and proposal to build an "up-to-date" steel mill. The new company expended \$400,000 for improvements, two open hearth furnaces, a train of rolling mills, and auxiliary equipment. Its owners assumed a profitable future as they estimated Pacific Coast manufacturers consumed over one million tons of iron and steel annually. Furthermore, Irondale Steel believed high transportation costs for imported steel from the East created a natural protective tariff.⁴⁶

Moore cleared and platted the Irondale townsite through the spring of 1909, modeling it after the "most successful industrial towns in the East"

(photo 41)⁴⁷. Local papers gave extensive coverage to Irondale's growth, extolled the area's advantages for iron and steel production, and outlined its potential as an industrial town. The Port Townsend Weekly Leader published stories about successful Irondale investors, and often compared the future of Irondale to Gary, Indiana, "one of the largest and most profitable manufacturing centers in the entire world." Regularly scheduled excursions, many arranged by Moore, brought visitors from all around Puget Sound to witness the bustling activity at Irondale. He aimed the trips toward promoting and encouraging outside investment. Irondale became so popular that many Port Townsend residents chartered steamers to take them there for the Fourth of July celebration in 1909 (photo 42).⁴⁸

By the end of the summer, Irondale Steel Company finished the preliminary work for the new steel plant. While laborers poured the foundations, Oscar Stromberg, consulting engineer from Seattle, designed two oil-fired 20-ton capacity open hearth furnaces (photos 28 and 29). Rail tracks on either side of the casting pit supported an electrically operated 25-ton ladle used to direct the flow of molten steel from the open hearth to the ingot molds below. The company ordered an 1800 horsepower Corliss steam engine, the largest "ever shipped to the Pacific Coast" (photo 33). This Corliss furnished power to the 22-inch rolling mills (photos 31 and 32). Workers poured the foundation for a new power house and installed six boilers to provide all the energy needs of the developing steel plant (photo 38).⁴⁹ Additional equipment continued to arrive as the outline of the Irondale steel operation took definite shape.

On October 2, 1909, Moore organized the Western Steel Corporation with a capital stock of \$20 million to take over the holdings of the Irondale Steel Company.⁵⁰ The area continued to boom as the owners and local population

planned on a grandiose scale. The Port Townsend Weekly Leader leaked information concerning a second steel plant in British Columbia and the possibility of Moran Brothers relocating its shipbuilding enterprise at Irondale. The New Jersey Pipe company negotiated a deal to acquire a suitable site close to the steel plant. Symington Brothers, a railroad car parts manufacturer from Baltimore, Maryland, also investigated Irondale as a possibility for expansion. Western Steel purchased milling equipment for a complete horseshoe plant in the spring of 1910 and housed it on the south side of Chimacum Creek, just north of its steel making site. Although never in production, the horseshoe industry was the only auxiliary business ever constructed at Irondale.⁵¹ Besides subsidiary plants, Western Steel looked forward to the building of a transcontinental railway line to the area.⁵² This dream, also a potential boon to the Olympic Peninsula, never materialized.

However, work on the steel plant progressed in realistic form throughout the spring of 1910. Western Steel drafted designs to reclaim 100 acres of tidelands for expansion and at the same time increased the harbor's depth to accommodate larger ships. Construction workers completed the open hearth furnaces, rolling mills, and steam plant by the end of March. Other steel making equipment such as scrap shears, generators, a pumping system, skull cracker, billet shears, and rolling lathes arrived at the Irondale wharf, ready for installation. The first fuel oil shipment was transferred to a steel lined concrete tank of 6,000 barrels capacity just south of the blast furnace area. Laborers in the meantime surveyed and graded the right of way for a small railway to transport raw materials and finished steel products around the plant (photo 39).⁵³

In April, wood fires lit under the open hearths to dry the furnace chambers sent the first smoke through the new chimneys. After several weeks, workers coated the open hearth bottoms with a mixture of 80 percent burnt magnesite and 20 percent basic slag.⁵⁴ As the steel plant prepared for its first charge, publicity and promotion testified to Irondale's importance to the region's economy. The Irondale News announced that the "commencement of operations in the plant . . . will certainly mark an important epoch in the history of empire building in this great new Northwest country."⁵⁵

The phenomenal growth of the town of Irondale reflected its faith in the success of Western Steel's ambition. Although established in the early 1880's, Irondale's population totalled only 150 in 1909. As quickly as the steel plant developed, however, the town boomed with the promise of becoming the "Steel City of the Pacific Coast." After filing the Irondale plat in 1909, Moore sold lots and used the proceeds to invest in the steel plant. He claimed the double purpose established by other industrial cities of providing workmen a "convenient place of abode" and at the same time a share "in the profits" from platted lands. After production began, Western Steel transferred to the Irondale Realty Company all land holdings not essential to steel making.⁵⁶

By February 1910, Irondale's population climbed to several hundred. The town boasted graded streets, a hotel, steam heat, electric lights, a newspaper, six store and office blocks, a school, and a complete water system. In addition, the Northwestern Hospital Company contracted with Western Steel to build a hospital, paid for by mandatory deductions from workers' wages.⁵⁷ While construction transformed the landscape, Western Steel continued to bring in visitors with financial interests to view the expanding town and plant (photo 37). A large influx of workers, many traveling from the East

with their families, also added to the general excitement. Within a year and a half, the population reached 1400, of which four hundred worked for Western Steel. Irondale took on the appearance of a well functioning city.⁵⁸

While construction in the town and steel plant progressed, local newspapers churned out a constant flow of editorial boosterism. The Irondale News challenged the long established eastern industry, better known as the "steel trust," and claimed that "one indisputable fact should be kept constantly before the eyes of the public," namely that "both pig iron and steel can be manufactured here at a lower price than is possible in the eastern mills."⁵⁹ However, Western Steel relied on eastern experts to compensate for its lack of steel making knowledge. The company brought Carl E. Maeder, former superintendent at Duquesne Mills of United States Steel Corporation in Pennsylvania, and promoted him to general superintendent for the Irondale works. N.V.F. Wilson resigned a managerial position in a Pittsburgh steel plant to assist Maeder.⁶⁰

Success of Western Steel's long range goals depended on access to an unlimited supply of high quality raw material deposits. To satisfy this need, the company signed a contract in March 1910 with the Han Yeh Ping Iron and Coal Company of Hankow, China, for 200,000 tons of pig iron and iron ore each year for 15 years.⁶¹ The transaction represented one of the largest contracts ever signed between the Chinese and a foreign power. Furthermore, since the imperial government held a direct interest in the Han Yeh Ping Company, Moore viewed the contract not only as a great asset for Western Steel, but also as an "expression of friendliness" which might "bring about advantageous trade relations" between China and the business interests of Puget Sound. The first shipment, of 1,500 tons of pig iron and 5,000 tons of iron ore, arrived at the Irondale dock on June 10 (photo 40). The Dollar

Steamship line handled this and most subsequent shipments. Importation continued except during December and January when low water in the Yangtze River made the inland Han Yeh Ping Company inaccessible to ships.⁶²

In addition to the China contract, Western Steel acquired ownership of a number of raw material claims. The company bought a ten million ton bog iron deposit at the Quatsino Sound Mining District of British Columbia. Property on Barclay Sound, British Columbia, contained a deposit estimated at almost four million tons of magnetic iron ore. The company also purchased a tract consisting of 12 million tons of ore in Lyon County, Nevada, to serve as a reserve supply. Steamers transported coke from deposits located at Ashford in Pierce County, Washington, and Graham Island, British Columbia. An "inexhaustible" quarry in Skagit County, Washington, furnished limestone for fluxing in both the iron and steel making process.⁶³

On May 26, 1910, Western Steel's employees introduced a charge of pig iron and scrap into the first open hearth furnace (photo 30). Later that night, Harry Bevan, superintendent of the open hearth department, tapped the furnace and turned out the first Irondale steel. Molten metal poured from the open hearth tapping spout into a 25-ton ladle, which then passed over a line of molds forming ingots of 965 pounds each, or about eight tons of finished steel. After testing, the steel proved to be extremely high in quality. Although the first charge was small, each furnace possessed a maximum capacity of 25 tons. In less than a month, both furnaces operated on a 24 hour basis and steel workers tapped each two to three times daily.⁶⁴

After producing a large stock, mill workers placed the ingots into the reheat furnace which turned them a glowing red. A crane hoisted the ingots to the 22-inch mill's lifting table, where they passed back and forth through

rollers until attaining "hillet" shape. The steel then rolled through additional stands on the 22-inch mill to manufacture marketable shapes or were reheated and rolled on the 14-inch mill for small dimension bars (photos 31-36, see also Appendix II).⁶⁵ Irondale, at long last, had achieved full scale steel production.

With production barely started, Moore and Western Steel officers began implementing plans for expansion. Removal of the old charcoal kilns increased the size of the waterfront storage yards. A repair crew overhauled the wharf and extended the railroad track system to the entire length of the dock for easier access to the ore hunkers. The company poured the foundation for an additional open hearth next to the original two. During the summer, carpenters framed an office building for clerks in the rolling mill department. A new twisting bar machine produced steel reinforcing bars for the United States government for use in nearby military establishments. Other plans included installation of a new electric crane, automatic charging machine, and 40-ton ladles for the open hearth department, an electrically operated hillet conveyor, continuous heating furnaces for the rolling mills, a nine-inch rolling mill, and a skull cracker to break up scrap steel. During the next several months, Western Steel accomplished most of these improvements (see Appendix II).⁶⁶ Reflecting a national trend in the iron and steel industry, the Irondale changes demonstrated that labor saving devices increased the plant's output and provided greater profits.

While the steel plant received publicity and attention, Western Steel did not neglect the blast furnace. During the spring of 1910, laborers relined its base with firebrick. The company expected to produce most of the pig iron needed to make steel in the open hearths. Chinese iron ore, mixed

with equal amounts of British Columbia and Washington ores, produced a "superior" grade of iron. Blown in on July 5, the furnace turned out 60 tons of pig iron daily and increased its output to 90 tons shortly thereafter (photo 22).⁶⁷

A new foundry department, in conjunction with the blast furnace, began ingot mold and iron casting production in the fall of 1910. Foundry personnel made tool and machinery parts for use in the iron and steel plant, thereby avoiding delay from factory centers in the East. By October they turned out three to four tons of finished iron per day, so large an output that it necessitated doubling the size of the casting house. Eventually, Western Steel cast its own steel and shaped rollers for the rolling mills. In November, the company installed a 12-ton cupola to melt iron used for castings. By the end of the year, the foundry department claimed to be the fastest growing asset in the entire Irondale iron and steel operation.⁶⁸

The Oregon Railway and Navigation Company, as well as a number of local manufacturers and hardware dealers in the Seattle area, purchased Irondale's first finished steel. Within a short time, the plant produced 700 tons of steel ingots weekly and rolled these into 690 tons of finished merchant bar. Existing orders kept the plant functioning day and night, and daily shipments prevented stock build up. The company sales manager reported substantial profit as representatives scoured the West Coast for prospective buyers.⁶⁹

Further testing showed the structural quality of the Irondale product "far in excess of what government demands in its specifications." Satisfied customers testified to its excellence and expressed relief that they no longer depended on eastern industries for their building needs. Despite a general depression felt by iron and steel producers all over the country, Irondale's sales continued to climb.⁷⁰ Its success prompted the Irondale

News to report that "this city would repeat the history of the steel centers of the east, south and west" and possessed a future "brighter by far" than some that had become world famous.⁷¹

James A. Moore, recognized by his contemporaries as the "wizard of the real estate field of Seattle," devoted a large portion of his time traveling to promote Western Steel and seeking new investors. By July 1910, about two million dollars, representing investments from Seattle, British Columbia, San Francisco, and New York, poured into his enterprise. In October, Moore returned from New York and announced the acquisition of \$10 million for future expansion and development. He placed a \$2 million mortgage on Western Steel properties in favor of the Carnegie Trust Company of New York, who served as broker for the bonds. This prompted local speculation to predict the employment of 5,000 men within three years.²⁷ Few people, however, guessed the coming of Western Steel's imminent bankruptcy. Moore, a man who made a lot of money selling real estate in Seattle, now played for big stakes in a new market dominated by more experienced eastern financiers.

COLLAPSE OF IRONDALE'S INDUSTRY

Western Steel's plant closed for a week during Christmas of 1910 to allow for the installation of new machinery.⁷³ Despite the temporary shutdown, the company's business culminated at an all time high. It received orders from as far east as the George A. Lowe Company in Ogden, Utah, and as far south as the Union Hardware and Metal Company of Los Angeles. In early 1911, substantial orders for Irondale structural steel arrived from the Stone and Webster Construction Company and the Great Northern Railroad Company; both were engaged in major improvements and tunnel construction in western Washington. The construction of a commercial club in Tacoma and the St.

Ignatius Church in San Francisco also utilized Irondale's products. A \$125,000 deal with the Leonard Construction Company of Chicago (doing business on the Pacific Coast) represented the largest contract with a local firm to date. The Irondale company continually broke its own monthly sales records.⁷⁴

Despite high sales, the company faced serious financial trouble when Moore received word that Carnegie Trust suspended business the first week of January 1911.⁷⁵ After spending large sums of money building the Irondale steel plant and buying raw material deposits, the company now needed additional capital to keep the venture operating. In late January, Metropolitan Trust Company of New York lent Western Steel \$300,000 and Moore traveled to Europe to find additional investors. In a short time he announced a \$10 million loan from British capitalists, but for reasons unknown, the deal fell through. Moore returned to Europe and succeeded in a \$5 million deal with French bankers. However, when he returned to New York, the Metropolitan Trust increased its original loan to \$600,000 for four months. Moore put up \$2 million in bonds as security and understood that the Trust Company would arrange for further financing.⁷⁶

Leslie M. Shaw, former Secretary of the Treasury under Presidents McKinley and Roosevelt, accompanied Moore on his return trip to the West in April. Moore expected Shaw to rally local financial interest in support of the plant and gain recognition from the First Mortgage Warranty and Trust Company of Philadelphia. In May, Western Steel elected Shaw and seven leading Seattle bankers to the Board of Directors, thus signifying their approval of the venture. Two months later, Western Steel stockholders authorized a corporate bonding indebtedness of \$5 million, to allow for further expansion to the Irondale Plant.⁷⁷

Although financial arrangements for the first half of 1911 seemed at best shaky, Moore continued to carry out his great industrial plans. Early in January he secured a site near the city of New Westminster, British Columbia, for the proposed second steel plant, and a month later purchased additional ore beds on Louis Island, British Columbia, for \$100,000. Western Steel's monthly payroll climbed to \$28,000 while the workers installed a steady stream of new equipment intended to further improve the plant and allow for more efficient production. An electrically operated charging machine, used to fill the open hearth furnaces, cut labor time from three hours of strenuous work to a mere half an hour. In addition, construction of the third open hearth progressed as workers lit drying fires in May.⁷⁸

The large volume of sales and continual improvements gave Irondale the appearance of a successful industrial enterprise. Iron and steel workers, as well as local residents, believed in their security, prosperity, and growth. The Irondale News, in a booster campaign, viewed Western Steel's success as an incentive for allied industries to locate on the west side of Puget Sound and predicted the spread of manufacturing activities to all parts of the Olympic Peninsula.⁷⁹ Then, on October 12, 1911, Irondale's dreams burst as Metropolitan Trust filed a petition for Western Steel's involuntary bankruptcy at Seattle's United States district court. On October 23, Moore answered the petition by denying Western Steel's insolvency. A federal judge appointed temporary receivers to hold the property until the court made a decision on the bankruptcy proceedings.⁸⁰ In the meantime, all Irondale iron and steel production ceased.

Rumors to the effect that the United States Steel Corporation tried to force Western Steel out of business circulated throughout the Puget Sound area. However, regardless of the accusations, Western Steel's failure to

meet the \$600,000 repayment deadline caused Metropolitan Trust to foreclose.⁸¹ To avoid a loss in value of the Irondale plant, company creditors voted in December to place the plant on the market for immediate sale and settle outstanding claims against Western Steel. Irondale workers also hoped for an early settlement as Western Steel owed them \$27,000 in back wages.⁸²

In February 1913, the Port Townsend Weekly Leader announced the federal court's decision for a March 15 sale date for the Irondale property. Metropolitan Trust, using its \$2 million of Western Steel security bonds, purchased the plant.⁸³ The following June, Moore sued the Trust Company, stating that Metropolitan and United States Steel conspired to bankrupt Western Steel. Furthermore, Moore alleged that Metropolitan improperly used its security bonds to bid on the Irondale property. Between June 1912 and February 1913, Moore tried in vain to move the court proceedings to Jefferson County where he enjoyed tremendous support. However, the Washington State Supreme Court denied a change of venue. The corporate battle lasted until February 8, 1913, when a King County federal judge upheld Metropolitan's claim to Western Steel's assets. In April, a federal court dismissed Moore's charge of conspiracy and thereby eliminated his claims on Western Steel Corporation.⁸⁴

By September 1913, Metropolitan settled all outstanding claims, including back pay for the Irondale workers and announced its intentions to sell the plant to Pacific Coast Steel Company of Seattle. The sale, finalized in January 1914 for a net sum of \$300,000, once again created an air of speculation in Irondale as residents predicted the plant's reopening. However, to the disappointment of all, Pacific Coast Steel sent 40 of its employees to dismantle and ship the steel plant to Seattle. After three months, only the foundations and empty buildings of the once busy steel plant remained.⁸⁵

The town of Irondale followed a similar fate. In 1911, many residents believed that Moore would eventually win the bankruptcy suit and start the steel plant running again. Support in the press exemplified his popularity among local citizens. As time dragged on, however, many businessmen and residents drifted away. In October 1914, the Seattle Post-Intelligencer reported the scene at Irondale as "gradually going down, little remaining of the residence district but vacant houses." At the same time, a fire swept through Irondale and destroyed the town's main business district. By the end of 1915, Irondale's population decreased from its all time high of 1,400 to a mere 200.⁸⁶

The relative quiet settling over Irondale broke once again in 1917 when high prices for pig iron during World War I led Pacific Coast Steel Company to reopen the iron plant. During the summer, 30 workers completed repairs made necessary by natural deterioration and "marauders" carrying away vital parts of the machinery. The blast furnace, blown in on September 10, used coke and left-over Chinese iron ore from Western Steel days. Pacific Coast Steel turned out 40 to 60 tons of pig iron daily and shipped it to their Youngstown plant in Seattle where steel makers transformed it into finished products.⁸⁷

West Coast shipbuilders, under contract with the federal government, bought the steel and used it to construct warships.⁸⁸ The furnace shut down for the final time on February 27, 1919, when the company employees exhausted the supply of raw materials. High cost of production combined with a drop in demand for iron and steel at the end of the war made operation of the plant unprofitable. At the end of the year, a dismantling crew tore down the blast furnace and all auxiliary machinery and sold them as salvage.⁸⁹

CONCLUSION

Irondale's dreams of an industrial empire ended after almost 40 years of iron and steel manufacture on the Olympic Peninsula. Its failure can be explained by examining basic considerations which include "iron ore, fuel, fluxes, price of labor, and nearness to markets."⁹⁰ The iron ore deposit in the Chimacum Valley proved to be poor quality and in short supply. This necessitated the importation of ore from both British Columbia and China, which added to its price. Fuel problems, also an expensive proposition, continually handicapped the plant throughout Irondale's history. The cost of labor remained high because a lack of skills locally forced owners to bring experienced workers and managers from the East. A limited market further restricted the industry until a growth in population and industrial activity, especially in the 1940's, served to increase demand.⁹¹

Ironically, even as Irondale failed, the steel industry on the West Coast, boosted by World War I needs, entered an era of prosperity. By 1922, 20 open hearth furnaces smelted steel in California, Oregon, and Washington. Pacific Coast Steel Company operated four in West Seattle. All the furnaces, however, manufactured steel solely from scrap because of its accessibility and relatively low price.⁹² On the other hand, eastern plants, in close proximity to vast iron ore deposits and coal regions, used pig iron as their principal ingredient.⁹³ Despite eastern manufacturing advantages, a desire in the West for self-sufficiency led to the inauguration of iron and steel production there.

The attempt at Irondale proved premature. Promoters miscalculated the value of local ore and fuel resources as well as the amount of capital needed to maintain a competitive business. Furthermore, the area lacked the population base necessary to support an industry of the size that the owners

envisioned. Irondale, like so many gold and silver mining towns of the previous century, passed into oblivion. Today, where the plant once stood, a mass of brick and concrete foundations hidden by natural growth survives as a monument to those who dared to initiate a western industrial economy.

APPENDIX 1

PIG IRON MANUFACTURE

1. BLAST FURNACE BLOWING IN

- A. DRYLING: Before the actual smelting process can begin, the blast furnace must be thoroughly dried to evaporate water absorbed by the brick during construction. This initial stage takes several days--if the blast furnace is heated too fast, it could be damaged.
- B. FILLING: Placing iron ore (containing approximately 60 percent iron), fuel (charcoal or coke), and flux (limestone) according to a carefully arranged ratio into the blast furnace. The combination of approximately two tons of iron ore, one ton of fuel, half a ton of flux, and four tons of air (hot blast) would produce one ton of pig iron.
- C. LIGHTING: Blowing a hot blast into the furnace burns the fuel and begins the smelting process.
- D. OPERATING: The actual smelting of iron with the blast furnace, hot stoves, blowing engines, boilers, and pumps all working in unison. The generated heat melts the iron ore and limestone; the iron, being the heaviest, sinks to the bottom of the hearth. The limestone unites with the non-metallic elements of the iron ore to form a slag which floats on top of the molten iron.

1. At Irondale, a single charge required between seven and eight hours; therefore, three charges a day were possible.
2. After a few days running, the operation becomes routine.

II. PIG IRON

- A. Pig iron is deoxidized iron ore--it contains between 2.5 and 4.5 percent carbon content received from the fuel charge.
- B. Pig iron by itself is not a finished product. It must be reheated and then rolled or milled into iron products or can be further treated (as in an open hearth) to produce steel.

III. BLAST FURNACE BLOWING OUT

- A. When a blast furnace reaches the end of its campaign (firebrick lining worn out), it is usually blown out. This is accomplished either by stopping the charge and allowing the heat to reduce slowly or by adding silica gravel to snuff the fire.
- B. The blast furnace is cleaned and the old firebricks replaced with new ones. The blast furnace is then ready to be dried and blown in again.
- C. Blowing out is standard practice.

- IV. BLAST FURNACE--as described from the top of the furnace down.
- A. SHELL: The outer metal lining of the blast furnace which gives it shape and keeps the inner brickwork in place. Workers constructed the Irondale furnaces with boiler plate in "shingle" fashion; that is, the edges of adjacent plates were overlapped and riveted.
 - B. THROAT: The top of the furnace into which the charge (iron ore, fuel, and flux) is dumped.
 - C. BELL AND HOPPER: A sealing-type device located in the throat used to keep carbon monoxide gases from escaping.
 - D. DOWNCOMER: A duct located near the top of the furnace designed to channel carbon monoxide gas under the boiler house and hot stove where it burns as a fuel.
 - E. SHAFT: The part of the furnace which runs from near the top of the furnace down to the mantle.
 - F. MANTLE: A heavy steel ring which supports the blast furnace shell and brickwork of the shaft so that the hearth and bosh brickwork may be removed for repair without disturbing the shaft brickwork.

- G. BOSH: The inverted conical section of the furnace where melting begins. Water flowing through metal pipe embedded in the fire-brick lining keeps the bosh from melting.
- H. HEARTH: The area directly below the bosh where molten iron and slag collect. It is sometimes referred to as the crucible.
- I. TUYERE: A nozzle-like casting into which the heated blast (air) enters the furnace.
1. The bustle pipe, which encircles the furnace, distributes the hot blast to the tuyeres.
 2. The bustle pipe receives the hot blast from the blowing engine and hot stove.
- J. SLAG NOTCH: A hole located a few feet above the iron notch used to rid the furnace of slag (waste) material.
- K. IRON NOTCH: A hole located at the bottom of the hearth where the molten iron leaves the furnace on its way to the casting house. The slag and iron notches are plugged with clay during charging.

V. BLAST FURNACE AUXILIARIES

- A. CHARCOAL KILN: A heating oven used to reduce wood to charcoal.

1. Charcoal is used as a fuel for smelting in the blast furnace and to supply the chemical reactants (primarily carbon monoxide gas) for reducing iron ore to iron.
 2. Irondale had 20 charcoal kilns each 30 feet high and 30 feet in diameter. They were dismantled when Western Steel Corporation decided to use coke.
- B. ROASTING PIT: An area where the iron ore is preheated to rid it of any volatile material, especially moisture.
- C. ELEVATOR: Used to carry iron ore, fuel, and flux to the top of the blast furnace.
- D. BRIDGE: A span over which the iron ore, fuel, and flux are transported in wheelbarrows or wheeled carts from the elevator to the charging floor. The men in charge of this operation are known as top fillers.
- E. CHARGING FLOOR: The area immediately surrounding the top of the blast furnace from which the charge is introduced.
- F. HOT STOVE: Built of firebrick encased in boiler plate. Its function is to preheat the blast (air) before its admission into the furnace.
- G. BLOWING ENGINE: A steam driven machine used to compress air into the hot stove before being blasted into the furnace.

- H. BOILER: Used to furnish steam to the blast furnace pump, blowing engine, hoisting machine at the elevator, and the crusher at the roasting pit.
- I. PUMP: Used to circulate water in the metal pipes embedded in the bosh and hearth firebrick of the blast furnace. At Irondale, the pump was located in the engine house.
- J. WATER LINE: A water pipe running from Chimacum Creek to the blast furnace.
- K. CAST HOUSE: Area adjacent to the blast furnace where molten iron runs from the furnace to sand casts known as sows and pigs because of their shape.

APPENDIX II

STEEL PRODUCTION

INTRODUCTION: Western Steel Corporation's plant at Irondale employed the basic open hearth method in its steel making process. The charge consisted of a combination of pig iron produced from Western Steel's Irondale blast furnace along with iron and steel scrap obtained from various localities on the Pacific Coast. Employees introduced this charge to the open hearth at its charging aisle. As soon as the charge melted and its carbon and phosphorus content diminished, the workers tapped the open hearth at its pouring aisle, allowing the molten steel to run into a rail mounted ladle which then passed over a line of ingot molds. When cooled, a crane stripped the molds and transported the ingots to a reheat furnace. From the reheat furnace, ingots traveled over an electric conveyor to the 22-inch mill for shaping and then on to the billet shears for cropping. The billet passed back to another stand of rolls on the 22-inch mill for final shaping or on to the 14-inch or nine-inch mills. Once shaped, the steel bars were cut to length at another set of shears, then moved on to a rolling lathe for dressing or to the cooling bed as a finished product.

- I. OPEN HEARTH: The open hearth derives its name from the fact that steel, while melted on a hearth, is accessible through furnace doors for inspection, sampling, and testing. Its process consists in melting by direct flame action a mixture of pig iron and iron and steel scrap. Refined steel contains approximately one percent carbon. Western Steel possessed basic open hearth furnaces of 25 ton capacities. The term "basic" denotes the act which permits the charging of

limestone for the removal of phosphorus during the steel making process. The open hearths were lined with basic firebrick and then coated with a layer of burnt dolomite or magnesite.

A. FUNCTIONAL PARTS OF THE OPEN HEARTH

1. BATH: The area of the open hearth where cold pig iron with iron and steel scrap are melted and refined into steel.
2. SLAG POCKETS: Located below and on either side of the bath area. They serve to catch slag and other impurities produced by the steel making process.
3. REGENERATOR CHAMBERS: Located below the bath elevation and behind the slag pockets. They contain a checker work of firebrick which store heat transferred to them from the products of combustion, and subsequently impart the heated gas and air to the bath area. There are two pairs of regenerators for each open hearth.
4. TAPPING SPOUT: Located midway between the ends of each open hearth on the pouring aisle side. The tapping spout is plugged with clay while the furnace is charging.
5. CHARGING DOORS: Located at the charging side where steel making ingredients are introduced to the open hearth.
6. FUEL SOURCE: A mixture of hot atomized fuel oil and air burned in the bath area. At Irondale, oil was piped from a 6,000 bbl steel lined concrete storage tank located about 170 feet south of the blast furnace.⁹⁴

B. CHARGING AISLE OF THE OPEN HEARTH

1. CHARGING MACHINE: An electrically operated machine, set on rails and equipped to pick up boxes one at a time from charging buggies. The machine thrust the boxes through the charging doors into the open hearth furnace and turned them to dump their contents onto the hearth (bath). Tracks extended down to the waterfront scrap and pig iron storage beds.⁹⁵
2. Prior to setting up the electric charging machine at Irondale, laborers fed the open hearths by hand.⁹⁶

C. POURING AISLE OF THE OPEN HEARTH

1. LADLE: A large metal container used to direct the flow of molten steel from the tapping spout to the ingot molds. At Irondale, an electrically operated 25-ton ladle mounted on rails spanned a casting pit in front of the open hearth.⁹⁷
2. INGOT MOLD: A steel molding used to give initial shape to the molten steel.
3. ELECTRIC CRANE: Stripped the molds from the ingots and removed them to the reheat furnace to begin the initial step of milling. Irondale's 15-ton crane was adjacent to the ladle tracks.⁹⁹

11. REHEAT FURNACES: The reheat furnace raises the steel's temperature in preparation for hot work or milling. The ingots remain in this furnace until they are sufficiently hot or plastic enough to be rolled to the desired shape.
- A. Western Steel built two reheat furnaces in 1909 for the 22-inch mill, each five feet nine inches wide and thirty feet long, with quartz hearths and outside walls and roofs of firebrick. Construction of the 14-inch mill's reheat furnace was similar.¹⁰⁰
- B. The company installed a continuous reheat furnace for the 14-inch mill in October 1910.¹⁰¹ This new device enabled ingots to pass automatically through the furnace.
- C. In April 1911, Western Steel's general superintendent, N.V.F. Wilson, patented a continuous reheat for the 22-inch mill which eliminated the manually operated ones. His furnace featured upper and lower floors. The ingots received heat on one side while pushed automatically through the top floor. As they fell to the second floor, they turned and the furnace heated the other side.¹⁰²
111. ROLLING MILLS: The standard process for shaping steel consists essentially of passing it between two rollers revolving at the same speed and in opposite directions and spaced somewhat less than the object passing through. Due to the basic nature of ingot steel, one pass through the mills is not sufficient to produce the desired shape.

Therefore, the mills are arranged in stands with a specific number of rollers in each. The steel product passes back and forth through rollers of the same stand and then on to the next for further reduction. Roller size reflects the diameter of the rolls, or how large a product the mill will make.

A. IRONDALE ROLLING MILLS

1. TWENTY-TWO INCH MILL: All Western Steel ingots passed through a stand on this mill for billet shaping. The square billets ranged from 2 x 2 to 5 x 5 inches. Mill workers rolled them into angles 3 x 3 x 1/4 to 5/8 inch and 6 x 6 x 3/8 to 7/8 inch; 4 and 6 inch channels; 4 and 6 inch I-beams; and flats up to 8 inches wide and from 1/4 to 1 inch thick.¹⁰³
2. FOURTEEN INCH MILL: Rolled steel from the 22-inch billet stand into rounds 1/4 to 4 x 1 inch; 3 inch channels; angles from 1 1/2 x 1 1/4 x 3/16 inch to 2 1/2 x 2 1/2 x 3/16 to 1/2 inch; and octagons 3/4, 7/8, and 1 inch.¹⁰⁴
3. NINE INCH MILL: Produced finished merchant bar from 3/16 inch rounds, squares up to 4 inches, and small flats from band size up. This mill had four stands three high, one stand two high, and one stand with two sets of pinions.¹⁰⁵

B. POWER SOURCE FOR MILLING OPERATION

1. Power to drive the 22-inch mill came from a 36 x 60 1800 horsepower Corliss steam engine with a 40-ton fly wheel.¹⁰⁶
2. The 14-inch and nine-inch mills derived their power from a 30 x 60 1000 horsepower Corliss steam engine with a rope drum fly wheel connecting the two mills.¹⁰⁷

IV. AUXILIARY EQUIPMENT

- A. BOILER PLANT: A battery of six boilers of 500 horsepower each (three Badenhausen water-tube type designed by John Badenhausen of Seattle), located near the waterfront, supplied energy to the steam engines.¹⁰⁸
- B. POWER HOUSE: Two 30 kilowatt, three 60 kilowatt, and one 75 kilowatt Allis Chalmers engines and motors provided electricity to operate the electric charging machine, cranes, conveyor systems, lifting tables, shears, rolling lathes, grinding machine, and equipment in the machine shop.¹⁰⁹ This equipment was located in the power house near the blast furnace.
- C. MACHINE SHOP: Contained a Manning, Maxwell and Moore Lathe (30 x 16), a Pond planer (5 x 6 x 13), steptoe sharper, grinding machinery, forges, and accessory tools to make repairs around the iron and steel plants.¹¹⁰

D. ROLLING LATHES: The lathe for the 22-inch mill was a Hogg make with four speed changes driven by a ten horsepower Western Electric motor. The 14-inch mill used a Lewis Foundry lathe with three speed changes driven by a seven horsepower Westinghouse motor.¹¹¹ These lathes dressed and shaped rolls for Western Steel and its customers.

E. SHEARS

1. BILLET SHEARS: A Number 6 shears driven by a 20 horsepower motor cut billets to length.¹¹²
2. FINISH SHEARS: The 22-inch, 14-inch, and nine-inch rolling mills had hot shears of their own used to cut finished products to length.

F. YARDAGE AND WHARF EQUIPMENT

1. WHARF: The wharf was 600 feet in length with a 400-foot frontage and equipped with ore bunkers.¹¹³
2. ALLIGATOR SCRAP SHEARS: Located near the scrap storage beds, it cut the scrap to fit in the open hearths.¹¹⁴
3. SKULL CRACKER: Also near the scrap bed, it crushed large material "too unwieldy for the shears," by dropping a heavy hammer from a high elevation.¹¹⁵
4. RAILROAD EQUIPMENT: A four-coupled saddle tank Davenport locomotive, eight Moran dump cars, 15 all-steel Atlas cars, and about three miles of trackage were used to haul raw

material, scrap, and finished products about the plant. By the end of 1910, Western Steel possessed two locomotives and 35 flat ore cars.¹¹⁶

5. WEIGHT SCALE: Located on the wharf near the waterline, it weighed incoming ores and scrap and outgoing finished products.¹¹⁷

FOOTNOTES

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³ "Have We Iron," Washington Standard, 17 October 1879 and "Port Townsend Iron Works," Washington Standard, 17 December 1880.

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16 Engineering and Mining Journal of New York 47 (30 March 1889):308-309; and Daniels, Iron and Steel Manufacture, p. 30.

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¹⁹ Engineering and Mining Journal of New York 70 (11 August 1900):151; "Bright Future for Port Townsend," The Morning Leader, 10 November 1900; Daniels, Iron and Steel Manufacture, p. 30; and J.H. Cremer, "Irondale Blast Furnace--Iron Ore and Coal Deposits, Puget Sound Iron Co. Furnace Plant, 17 December 1900," in Pig Iron Manufacture at Irondale, Washington, compiled by Joseph Daniels for William Pigott, Puget Sound Steel Co., 30 November 1925, pp. 1-18.

²⁰ "History of Iron Industry Since Its Beginning Here," Irondale News, 5 February 1910; Cremer, "Irondale Blast Furnace," pp. 1-18; and Daniels, Iron and Steel Manufacture, p. 31.

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Francisco made its first crucible steel. Pacific Coast Steel Company of San Francisco constructed two 25 ton open hearths in 1910. It merged with the Seattle Steel Company, and the new Pacific Coast Steel Company began steel production in West Seattle on September 30, 1915, with a 40 ton open hearth. The Southern California Iron and Steel Company made its first steel in a 30 ton basic open hearth in 1915. The Lewellyn Iron Works at Torrance, California, began production with two 40 ton basic open hearths and a five ton electric furnace on October 1, 1916. Daniels, Iron and Steel Manufacture, pp. 27-55; Mathesius, "Raw Materials Problems;" Edward H. Frank, "A History of Bethelhem Steel on the West Coast," paper presented at the Association of Iron and Steel Engineers Western Conference, Stateline, Nevada, 29 June 1974; and Pigott, "Basic Open Hearth Furnace Practice," p. 5.

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ADDENDUM TO:
IRONDALE IRON & STEEL PLANT
Port Townsend vicinity
Jefferson County
Washington

HAER WA-7
HAER WASH, 16-PORTO. V, 1-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
PACIFIC WEST REGIONAL OFFICE
National Park Service
U.S. Department of the Interior
333 Bush Street
San Francisco, CA 94104

HISTORIC AMERICAN ENGINEERING RECORD
IRONDALE IRON AND STEEL PLANT

HAER WA-7

This document is an addendum to "Irondale Iron and Steel Plant, HAER No. WA-7" transmitted in 1983.

Location: The Irondale kiln foundations and walkway are located on the site of the Irondale Iron and Steel Plant (45JE358) within the Irondale Historic District (DT189), five miles south of Port Townsend at 526 Moore Street in Irondale, Jefferson County, Washington. The kiln area is situated along the shoreline in the southeast portion of the lower plant area, south of Moore Street and east of 4th Avenue. It is bordered on the south by Hadlock Avenue.

The historic district is bounded by Port Townsend Bay, an arm of saltwater opening on the north to Admiralty Inlet and the Strait of Juan de Fuca. The district remains are on top of a bluff overlooking the bay and the once thriving business community along Moore Street.

Section 35, Township 30 North, Range 1 West, SW $\frac{1}{4}$, SE $\frac{1}{4}$, Willamette Meridian
Section 2, Township 29 North, Range 1 West, NE $\frac{1}{4}$, NW $\frac{1}{4}$, NW $\frac{1}{4}$, NE $\frac{1}{4}$,
Willamette Meridian

USGS Port Townsend South, Washington, 7.5' x 15' Metric Quad., 1953,
photorevised 1981 (Figure 1)

UTM Zone 10, Easting 517325.088 mE, 5321119.091 mN, NAD 83

Date of Construction: 1884

Designer: Unknown

Builder: Pacific Iron and Steel Company of California

Present Owner: Jefferson County Parks and Recreation
Jefferson County Courthouse
PO Box 1220
1820 Jefferson St.
Port Townsend, WA 98368-0920

Present Use: The charcoal kiln features are archaeological remains found along the shoreline at Irondale Beach Park. The exposed archaeological remnants of seven kiln foundations now serve as visual reminders, along with other above-ground remains of the Irondale Iron and Steel Plant, of the site's industrial past. The remnants of ten additional kiln foundations are buried, two located north of the

exposed kilns and eight others adjacent to them along the west at the base of the bluff. The site is under development as a county park, with plans to incorporate the kiln features and other remains of the historic iron and steel plant in a public interpretation and outreach program that includes information on Irondale and its industrial past.

Significance:

The charcoal kiln features are the archaeological remains associated with the iron-making period of operations at the Irondale Iron and Steel Plant (45JE358). The kilns were an integral part of the onsite process of making charcoal, which supplied flux and fuel for the production of pig iron in the plant's blast furnace. Puget Sound Iron Company constructed twenty kilns in 1884 as part of an upgrade of the steel plant, and they remained in place until all of the above-ground portions were removed in 1910 when coke coal replaced charcoal for fuel. The plant is the main component of the Irondale Historic District (DT128), listed in the National Register of Historic Places and the Washington Heritage Register. It is significant as one of the first attempts to introduce heavy industry in western Washington through an efficient and modern manufacturing facility.

Project Information:

This documentation was prepared as a condition of the US Army Corps of Engineers permit issued for the 2012 Washington State Department of Ecology (DOE) environmental remediation project pursuant to Nationwide Permit 38, Terms and Conditions, Compliance with the National Historic Preservation Act. The documentation was funded by the Washington State Department of Ecology (DOE). Jessie Piper prepared the historic context, and Erik Anderson, photographer, provided the large-format photographs. Historical archaeologist Lorelea Hudson was in charge of project review. All are on staff at SWCA Environmental Consultants, formerly Northwest Archaeological Associates, Seattle, Washington. The report was prepared in August 2014.

The DOE contracted with GeoEngineers, Inc. (Geo) for engineering design of the environmental remediation project, and Geo contracted with SWCA Environmental Consultants, Inc. (SWCA) to monitor construction and complete HAER documentation of the kiln structures. Assistance and cooperation was provided by Steve Teel, DOE; Neil Morton, GeoEngineers, Inc.; and construction personnel. SWCA's Monitoring Program Manager, Michael Shong, and Archaeological Field Supervisor, Yonara Carrilho, ran the monitoring and documentation field project that provided technical data on the kiln features. They were supported by numerous SWCA archaeological technicians who assisted with monitoring and documentation of features.

The structures described in this report were documented during construction being carried out to remove contaminated sediments and slag left on the former site of iron and steel plant operations. The piecemeal nature of the exposure during construction, the presence of heavy equipment and site contaminants, and overriding concerns for health and safety resulted in limited access to the structures. Photo documentation was carried out in the midst of the archaeological monitoring, with construction work halted to allow the

photographer access to the site. Photos were taken as portions of kilns were temporarily exposed and prior to re-burial of a number of structures following cleanup.

PART 1 HISTORICAL INFORMATION

A. Physical History

1. Date of erection: 1884
2. Designer: Unknown
3. Original and subsequent owners: Pacific Iron and Steel Company of California (1882-1889); Pacific Steel Company (1901-1904); Seattle Iron and Steel Company (1903-1904); Irondale Furnace Company (1906-1908); Irondale Steel Company (1908-1909); Western Steel Company (1909-1913).
4. Builder, contractor, suppliers: Pacific Iron and Steel Company of California. Wood supplied by lumber mills throughout surrounding Puget Sound area.
5. Original plans and construction: None found.
6. Alterations and additions: Improvements made to charcoal production facility in 1906 with addition of new components that included sawmill log-splitting machine, and mechanized conveyance system for loading wood into kilns. Above-ground portions of the kilns were demolished in 1910.

B. Historic Context

This contextual information is a continuation of the Irondale Iron and Steel Plant History and Significance Section transmitted to the Library of Congress in 1983.

Introduction

The Irondale Iron and Steel Plant charcoal kilns were an integral part of the main period of iron making from 1884 until 1910, when conversion of the plant for steel production began and use of charcoal was replaced by coke coal and fuel oil for a short time. The Irondale kiln features documented here are the seventeen known foundations remaining from twenty beehive charcoal kilns built in 1884 to provide fuel and flux for the production of pig iron. The features represent the portion of each kiln that was constructed in the sand below surface elevation and are the only portions remaining since demolition of the main kiln structures in 1910.

HAER documentation was completed for major buildings and structures of the Irondale Iron and Steel Plant site in 1983.¹¹⁸ At that time, the HAER team produced a detailed plant history and mapped and illustrated the main buildings and infrastructure, relying on historic documents and the remains and footprints of the former structures, which had all been previously demolished. The 1983 history narrative referred to the kilns, but they were not specifically documented at that time.

¹¹⁸Diane Britton and J. D. Britton, "Irondale Iron and Steel Plant," HAER No. WA-7. Historic American Engineering Record (National Park Service, U.S. Department of Interior, 1983).

Industrial Use of Charcoal

Charcoal is the charred remains produced by burning wood at high temperatures in controlled conditions that result in slow charring that removes moisture and volatile chemicals. As a fuel, charcoal provides more heat per unit weight than wood and is lighter to transport. When heated for use as a flux in smelting, the carbon molecules in charcoal replace the oxygen molecules in iron, bringing down the melting temperature to produce a viscous iron that can be cast.¹¹⁹

Charcoal was an important raw material used in iron ore reduction (smelting) in the United States, and charcoal-iron was the only kind produced in the United States until the 1830s. Iron manufacturing was originally a locally oriented endeavor that produced small quantities of general goods for local consumption, and early industrial charcoal was manufactured in pits or earth mounds. These operations were usually located near a local iron supply and set-ups were small, scaled to local availability of wood supply and demand for products.¹²⁰ Because there was relatively little investment in infrastructure, a forge or small iron mill that supplied local markets could move on when the local ore supply ran out.¹²¹

After the 1830s, iron began to be produced using coking coal, but use of charcoal persisted, particularly where extensive supplies of timber and ore were found in close proximity. After the Civil War, changes in the market distribution system and the advent of mass production of specialized goods favored use of coke-produced iron.¹²² Even then, the chemical purity produced by charcoal in comparison with other flux materials made it preferable for some specialized uses, especially for those components that required strength or for tools such as scythes and chisels that needed to hold an edge.¹²³ Charcoal contains almost none of the impurities found in coke coal that weaken the structure of the iron or cause brittleness when heated in the blast furnace.¹²⁴

In the second half of the nineteenth century, charcoal making in kilns became the dominant production method due to the potential for increased yields and the ability to better control the burning process than could be accomplished in pit production.¹²⁵ The kiln provided a clean, enclosed environment that was protected from weather. Because large volumes of charcoal could be produced in areas where timber was abundant or easily transported, such as along rivers or developing railway lines, it offered an inexpensive method of producing both fuel and flux for smelting iron. Early kilns were simple constructions of brick or stone. Later in their

¹¹⁹ D. C. Gard, D. C. Smoke and Ash: A Study of 19th Century Charcoal Production in Montana and Idaho Using Parabolic Beehive Kilns, Master's Thesis, Interdisciplinary Studies History/Anthropology, University of Montana, (1998): 2, 10.

¹²⁰ Richard H. Schallenberg and David A. Ault. Materials Supply and Technological Change in the American Charcoal Industry, *Technology and Culture* 18:3 (1977):436, 446; Richard H. Schallenberg, Evolution, Adaptation and Survival: the Very Slow Death of the American Charcoal Industry, *Annals of Science* 32 (1975):342.

¹²¹ Schallenberg, 342.

¹²² Ibid., 343, 352.

¹²³ Ibid., 343.

¹²⁴ Gard, 12.

¹²⁵ Robert Gordon, *American Iron Industry 1607-1900* (Baltimore and London, Johns Hopkins University Press, 1996), 33-34.

development, they were often made of concrete with brick or stone lining.¹²⁶ The beehive-type kiln that came into use toward the end of the nineteenth century was extremely efficient because the arch formed by the top of the structure served to insulate and retain heat, while the parabolic shape reflected heat back into the center of the stack, providing more even heat.

As the nineteenth century drew to a close, changes in furnace design brought greater efficiencies, along with innovations that improved iron quality in coke-produced iron, allowing it to capture a greater share of the market. For a time, the availability of timber and the higher cost of specialty uses allowed charcoal-iron to hold a place in spite of the increased scale of coke-iron production. For example, charcoal iron was initially used in making locomotive wheels, crankshafts, axles, and running gear because of the high strength of the iron it produced.¹²⁷ But when the railroad freighting industry expanded and cars became larger and heavier, the charcoal-iron wheels would not support the increased weight as did those made from coke-produced iron.¹²⁸ As new alloys were developed along with other innovations in steel making that were able to fill the specialty niche once held by charcoal-produced iron, charcoal kilns were gradually abandoned, capital shifted its investments to more promising horizons, and pig iron production became an uncompetitive and outdated industry. The interplay of the availability and location of ore deposits, transport costs, technological and market changes favoring other raw materials, along with the depletion of America's vast stands of cheap timber eventually all contributed to the end of economically viable use of charcoal in iron and steel production.

Industrial Charcoal Use in the West

Use of charcoal for industrial purposes began early in the western states with smelting processes for mining operations that employed woodcutters and charcoal makers to stock the furnaces near the site of major silver and lead mines. Kilns for these operations were generally located in close proximity to a specific mine or group of mines and in most areas replaced earlier production of charcoal in earth pits.¹²⁹ These kilns were constructed of locally available materials with varying degrees of workmanship. Examples of remaining kilns from this period often exhibit skill that indicates they were built by knowledgeable craftsmen, but records of these economic endeavors tend to focus on the mining operations themselves as well as on economic analysis related to the general industry, and details of charcoal kiln construction and production tend to be sparsely and unevenly documented. Kilns were also used in the western states for lime production and for brickmaking, but these were structures designed for their specific functions.

¹²⁶ Robert Massengale, *Black Gold: History of Charcoal in Missouri* (Bloomington Indiana/Milton Keynes UK: Author House, 2006), 3-4, 5-8.

¹²⁷ Schallenberg, 352, 353.

¹²⁸ *Ibid*, 352, 357.

¹²⁹ Robert Frame, editor, "Forest Service Saves 1886 Charcoal Kilns," *Newsletter*, 16: 4 (Winter 1987), Society for Industrial Archaeology, 1; W. E. Wierprecht, National Register of Historic Places Nomination Form: Ward Charcoal Ovens, (National Park Service, 1971).

Some remaining examples of kilns used in ore smelting operations found in various locations throughout the western states provided insights into general construction and operation of charcoal kilns in an industrial setting. These include:

- Piedmont Kilns, NE of Hilliard, Wyoming (1869). Five conical structures were constructed of local sandstone with sand-lime mortar to supply smelting operations in the vicinity of the Union Pacific railroad station.¹³⁰
- Ward Charcoal Kilns, White Pine County, Nevada (ca. 1873). Six beehive kilns were built of quartz latite welded tuff by *carbonari*, itinerant Italian stone masons, to fuel silver smelters.¹³¹
- Frisco Charcoal Kilns, Milford, Beaver County, Nevada (1877). Five beehive kilns were built of granite float and lime mortar in a random rubble construction for silver smelting by the Frisco Mining and Smelting Company.¹³²
- Wild Rose Canyon Charcoal Kilns, Death Valley, California (1877). Ten beehive-shaped masonry structures of quarried chlorite stone with a sand-lime-gravel mix mortar built by the Modock Consolidated Mining Company to fuel two smelters in the Argus Range west of the Panamint Valley.¹³³
- Warren King Charcoal Kilns (Birch Creek Charcoal Kilns), Targhee National Forest, vicinity of Leadmore, Lemhi County Idaho (1886). Sixteen brick beehive kilns were built in 1886 to fuel smelting of lead and silver ore at the Viola Mine, the most productive of the Birch Creek Mines in eastern Idaho.¹³⁴

In about 1878, the first iron manufacturing venture in the west, the Oregon Iron Company (later the Oswego Iron Company and the Oregon Iron and Steel Company), built a set of charcoal kilns for their pig iron plant in the hills around Sucker Lake (now Lake Oswego) in Clackamas County. Forty-two brick beehive kilns, 30' high x 13' in diameter, were built in around 1867 to provide charcoal that was used for smelting at the iron works until 1894.¹³⁵

¹³⁰ Bill Barnhart, National Register of Historic Places Nomination Form: Piedmont Charcoal Kilns. National Register of Historic Places (United States Department of the Interior, National Park Service. Washington, D.C., 1971).

¹³¹ Ibid.

¹³² Phil Notarianni, National Register of Historic Places Inventory Nomination Form: Frisco Charcoal Kilns. (National Register of Historic Places. United States Department of the Interior, National Park Service. Washington, D.C., 1981).

¹³³ Merrill J. Mattes, and Robert V. Simmonds, Charcoal Kilns: Wildrose Canyon, Death Valley National Monument, Historic Structures Report (Western Service Center, History and Historic Architecture, National Park Service, Department of the Interior, San Francisco, California, 1970).

¹³⁴ Frame, 1987; James A. McDonald, Historic American Engineering Record - Warren King Charcoal Kilns (Birch Creek Charcoal Kilns), Forest Road 188, Targhee National Forest, Leadmore vicinity, Lemhi County Idaho, HAER No. ID-11 (National Park Service, Western Region Department of the Interior San Francisco, California, 1980), 2.

¹³⁵ Joseph Daniels, "History of Pig Iron Manufacture on the Pacific Coast," *Washington Historical Quarterly* 17 (July 1926): 170-171.

Historical researchers have noted that blueprints and building instructions for charcoal kilns are rarely found among historical documents pertaining to sites where they were used. The process by which they were built seems to have been knowledge possessed and retained by skilled journeymen masons, who were usually brought in from outside the area specifically to construct the kilns.¹³⁶ The skill required to manage the kiln operation then moved onto the hands of master colliers who were also often brought in from other mining and iron-making areas in the South and East as new enterprises were launched in the West.

The Irondale Charcoal Kilns

Charcoal was used at the Irondale plant to provide fuel for the blast furnace and a flux that supplied chemical reactants necessary for reducing iron ore to iron.¹³⁷ From 1879 until construction of the kilns in 1884, the original owners of the Irondale plant, the Puget Sound Iron Company of Washington Territory, contracted with a local man, B.S. Miller, whose crew of about seventy men supplied the plant's blast furnace with charcoal produced in earth pits in the nearby town of Chimacum.¹³⁸ Hiring private parties to supply fuel proved unprofitable, and in 1884, during plant renovations, twenty charcoal kilns were constructed on a cleared area south of the main production facility. The new plant owners, Puget Sound Iron Company of California, hoped to reduce production costs by making their own charcoal on site rather than purchasing it from sometimes unreliable suppliers.¹³⁹ Although the new company estimated a need for 912 cords of fir wood per day for a successful smelting operation, they believed the local fir timber supply would last indefinitely.¹⁴⁰

Because of the expertise required to make charcoal, a veteran charcoal burner was brought in from Missouri to supervise operations of the charcoal plant.¹⁴¹ In spite of this shift to onsite charcoal production, the expense and volume of charcoal fuel required proved too expensive, as the Irondale kilns burned an estimated 180 cords a day when in production. These high costs along with other factors contributed to the plant's closure in 1889.¹⁴²

Many promises were made to restart production, but it was not until 1901 under the new ownership of the Pacific Steel Company that the plant underwent major renovations, the furnace was lit for the first time in twelve years, and production began once again. Among the improvements were changes to the charcoal production facilities to improve efficiency. During this period, various experiments were made to compare the efficiency of using charcoal alone, coke alone, or both in combination, but the company elected to continue use of charcoal, since their local supply of Skagit County coke was of low quality.¹⁴³

¹³⁶ Gard, 1998, 23-24.

¹³⁷ Britton and Britton, 1983, 3, 43.

¹³⁸ Britton, 13

¹³⁹ Ibid, 18; Britton and Britton, 1983, 6

¹⁴⁰ Britton, 13; Daniels, Joseph. *Iron and Steel Manufacture in Washington, Oregon, and California*. Engineering and Experiment Station Series, Report No. 2. (Seattle: Washington University Press, 1929).

¹⁴¹ Ibid.

¹⁴² Anonymous, "History of the Industry Since its Beginning Here," *Irondale News*, February 5, 1910; Anonymous, "Tells History of Irondale," *Seattle Post Intelligencer*, September 10, 1906

¹⁴³ Daniels, 180.

Other 1901 improvements included renovations of the kilns to put them in good operational shape. The company also placed a log splitting machine near the south end of the kiln area and constructed an onsite sawmill. A charcoal warehouse was situated east of the kilns and south of the main wharf. The company also introduced a mechanized conveyor system to automatically feed wood into the kilns, a move that they hoped would increase efficiency and lower costs related to fuel supply.¹⁴⁴ Log culls and seconds unsuitable for lumber were purchased from area logging companies and delivered by scow to the boom in front of the kilns. In the past, the kilns had been filled by hand, with finished material brought by cart to the elevator house. With the new equipment, kilns could be loaded and finished charcoal brought to the furnace elevator by mechanical means.¹⁴⁵ Various other attempts were made over the next few years to adapt production methods, until near the end of 1907, when an insufficient supply of charcoal forced the company to blow out the blast furnace. No pig iron production took place through 1908.¹⁴⁶

Shortly after the shutdown, owner James A. Moore announced the formation of a new company, the Irondale Steel Company, with backing from eastern capitalists. He began to make more plant improvements and also to plat and sell lots for an ambitious new plan to expand the Irondale town site. In October of 1909, he reorganized once again and formed the Western Steel Corporation, with capital stock of \$20 million. With this new monetary infusion, the company envisioned enlarging the furnaces and building coke ovens to replace charcoal kilns as they modernized the plant for steel production operations.¹⁴⁷ As Western Steel began to shift from the use of charcoal to coke coal around 1910, the old beehive kilns were demolished.¹⁴⁸ The charcoal production area between the bluff and the bulkhead was leveled and filled to make room for additional waterfront storage and an above-ground oil tank was placed in the northern end of the charcoal plant. The underground foundation portions of seventeen or eighteen of the kilns were left in place and further buried in fill as the area was prepared for expansion of staging and storage operations. The charcoal storage house became the coke warehouse.¹⁴⁹

Despite James Moore's grand plans, the additional capital needed for so many improvements and purchases of additional iron and coal properties did not materialize, and the company was forced to shut down. The blast furnace did not operate after 1910 and in 1911 all production ceased as the court became involved in settling the company's tangled financial affairs. To settle debts the plant was initially sold to one of its creditors, Metropolitan Trust, and then resold later in the same year to Pacific Coast Steel Company of Seattle. Rather than utilize the plant, the company dismantled much of the machinery and shipped it to their facilities in Seattle.¹⁵⁰

The Irondale plant had one more breath of life in 1917, when World War I demand for pig iron drove up prices and the Pacific Coast Steel Company found it financially feasible to resume

¹⁴⁴ A.W. Clapp, "Ironmaking at Port Townsend," *Engineering and Mining Journal of New York* 73 (January 25, 1902): 137-138; Anonymous, "Making Charcoal" *orning Leader*, July 7, 1901; Anonymous, "Ironmaking to Begin at Port Townsend," *Seattle Post Intelligencer* October 13, 1901.

¹⁴⁵ Clapp, 137-138.

¹⁴⁶ Britton, and Britton, 1983, 14.

¹⁴⁷ Anonymous, "Will Be Rolled on Pacific Coast - Irondale Company Reorganized," *Iron Trade Review* 44 (January 7, 1909):120.

¹⁴⁸ Britton, 59-60.

¹⁴⁹ Britton and Britton, 1983, 21.

¹⁵⁰ *Ibid.* 24-26; Daniels, 182.

production. Company workers made sufficient repairs to put the blast furnace back into operation for pig iron production. The pig iron was then shipped to the larger mills in Seattle, where steel was produced primarily for warship production. By early 1919, this demand also began to ebb, and the Irondale furnace was permanently closed and then torn down, with its additional machinery sold for parts and materials. The Irondale Iron and Steel Plant was at an end.¹⁵¹

In preparation for a Washington State Department of Ecology (DOE) environmental remediation project at the Irondale Iron and Steel Plant, a conditions assessment was conducted in 2011 to locate and assess features identified in the 1983 HAER documentation that were still present and to document any additional features that had come to light in ensuing years. The survey documented the foundations of seven beehive charcoal kilns that had been exposed by shoreline erosion since the plant's final closure in 1919.¹⁵² A photograph published in the *Seattle Daily Times* in 1950 shows that by that year, some portions of these structures were already exposed along the shoreline and were breaking into pieces.¹⁵³

During the DOE project in 2012, ten additional kiln foundations were documented as they were partially or fully exposed during removal of contaminated sediment and slag and the demolition of the 6,000 barrel (252,000 gallon) concrete fuel storage tank. These remains included eight structures in the western row and two additional structures in the eastern row. Four of the structures were found beneath the concrete fuel tank when it was removed during cleanup.¹⁵⁴ Note that these features are archaeological remains and not extant kiln structures.

The kiln foundations and associated features were documented as they were exposed. Following documentation, the western row of eight kiln foundations was reburied; the seven structures in the eastern row that had previously been exposed by shoreline erosion remain exposed. Two additional kiln foundations at the north end of the eastern row were reburied. The remnant of a central wooden walkway situated between the rows of kiln foundations was documented during the project but was removed from the site due to contamination.

Kiln Operations

No overall description of the supply and operation of the Irondale charcoal kilns was found during background research. Historic photos, journal articles, and general technical information on charcoal production and kiln operation were consulted to reconstruct the production sequence outlined here.

¹⁵¹ Britton and Britton, 1983, 26-27.

¹⁵² Ross Smith, State of Washington Archaeological Site Inventory Form 45JE358, on file at Department of Archaeology and Historic Preservation, Olympia, Washington (Seattle, Washington: Northwest Archaeological Associates, Inc. /SWCA Environmental Consultants, 2011); Ross Smith, *Conditions Assessment for the Irondale Iron and Steel Plant, Jefferson County, Washington* (Seattle, Washington: Northwest Archaeological Associates, Inc. /SWCA Environmental Consultants, Inc., 2011).

¹⁵³ Unknown, *Seattle Daily Times*, August 20, 1950.

¹⁵⁴ Michael Shong, Yonara Carrilho and Christian J. Miss, *Results of Cultural Resources Monitoring for the Irondale Iron and Steel Plant (45JE358) Historic District (DT 128) Remediation and Restoration Project, Jefferson County, Washington* (Seattle, Washington: Northwest Archaeological Associates, Inc. /SWCA Environmental Consultants, 2014), 8-9, 17, 30, 34-36.

Wood Supply to Kilns

In the initial period of charcoal production at Irondale, wood was likely obtained from the abundant supply of Douglas fir on nearby slopes and delivered downhill by chute to the kiln area. Given the constant need for a reliable supply of wood, it was later obtained in large quantities by contracts with local woodcutters for delivery by wagon or scow and unloaded at the pier alongside the kilns.¹⁵⁵

In 1891, the plant reportedly used Chinese laborers to cut wood at \$1.00 a cord.¹⁵⁶ By 1901 the plant employed some 100 people for felling trees and cutting wood.¹⁵⁷ The figure may have included wood needed for the factory's steam plant and steam operated lifts as well. A 1906 breach-of-contract lawsuit filed by the company against two brothers who had been contracted to provide wood also cited payment of \$1.00 per cord and stated that the contract called for the sawyers to provide 10,000 cords.¹⁵⁸ This legal conflict may be an indication of problems with limits of the local timber availability and costs of transport that led the company to seek improvements in supply and delivery. At some point as the local stands of fir timber diminished, the need to secure a reliable source through area woodcutters led to increasing costs, and the plant began to contract with sawmills around Puget Sound to obtain seconds and butt ends that were not valued as timber. Timber loaded in the kilns produced better yields when cut along the grain and had to be cut to specified size. If the timber did not arrive roughed out from sawmills, time had to be invested at the plant to prepare it to specification.

Once wood was delivered to the kiln-side wharf, it was moved by trolley cart to each individual kiln where a boom or crane cart system could raise it to the upper level. Wood was also delivered at the south end where there a historic diagram indicates an incline or bridge provided access to the lower walkway, and a simple incline winch system was also in place for access to the upper doors.¹⁵⁹ Linkages between the upper and lower deck are not apparent in historic photos but steps and ladders, possible lift or incline areas were likely situated in various locations along the structure to allow movement of personnel and equipment between the two levels throughout the charcoal area.

In 1901 during plant renovations, the charcoal production facility was upgraded with a mechanical conveyor system for supplying wood.¹⁶⁰ It was situated on pilings in the water perpendicular to the walkway structure between the third and fourth kiln on the eastern side.¹⁶¹

¹⁵⁵ Anonymous, "Irondale Furnace, Washington," *Journal of the United States Association of Iron Charcoal Workers* 9:1 (1891): 25.

¹⁵⁶ Ibid.

¹⁵⁷ Joseph Daniels, *Iron and Steel Manufacture in Washington, Oregon, and California*, Engineering and Experiment Station Series, Report No. 2 (Seattle: Washington University Press, 1929); Clapp, 137-138.

¹⁵⁸ John B. Allen, *Puget Sound Iron Company vs Worthington et al.* Washington Territory Reports Vol. 2, Cases Determined in the Supreme Court of Territory of Washington 1880-1885, John B. Allen, Reporter (Seattle and San Francisco: Bancroft Whitney Company, 1906), 472, 474.

¹⁵⁹ Anonymous, "The Inauguration of Steel *Iron Trade Review* -Making on the Pacific Coast," 45 (August 19, 1909):334.

¹⁶⁰ Clapp: 137-138.

¹⁶¹ Asahel Curtis. Irondale. Order Number CUR83, University of Washington Libraries' Special Collections, Asahel Curtis Collection, University of Washington Libraries, Manuscripts, Special Collections, 1901, In In Diane Britton and J. D. Britton, "Irondale Iron and Steel Plant." HAER No. WA-7. Historic American Engineering Record (National Park

The conveyer linked with both the lower level and the upper deck level, as wood had to be supplied to the kilns through both lower and upper doors. From historic photos, the conveyer appears to have been a relatively simply belt over rollers type of conveyance system that brought logs from the delivery point on the wharf-side to the appropriate location for loading into the kilns.¹⁶² It was noted that once the logs were loaded onto the conveyer they were not handled again by workman, implying that some adjunct structure or slab truck moved along the upper deck to enable loading of each group of two kilns through upper level doors.¹⁶³

Another innovation provided by these upgrades included addition of a log splitter to which logs could be fed prior to conveying wood to the kilns. Depending on the status of the wood that was supplied, logs would have been fed directly to the kilns, to the log splitter for further preparation, or stored for a period in a log boom on the south end of the charcoal kiln production area.¹⁶⁴ After the 1901 renovations, little handling was apparently required once the initial wood was delivered to the plant and loaded onto the conveyer system.

Loading Kilns

The heavy iron upper and lower kiln doors were removed to load four foot sections of wood, through the lower level door, followed by loading of smaller pieces and butt ends on to the top of the load through the upper level door. Each kiln was estimated to have a capacity of about seventy-five to eighty cords each.¹⁶⁵ Wood was stacked in a manner that allowed air to circulate throughout to maintain an unimpeded flow of oxygen and facilitate even burning. A 1901 photo shows the view through the lower door into a loaded kiln, where each layer of wood is stacked perpendicular to the last to create a stable pile while ensuring good air circulation.¹⁶⁶

A pipe system built beneath the central walkway with lateral extensions to the kilns may have provided air continuously or as needed to invigorate the wood reducing process at various times during the firing, or the system may have supplied water to the charcoal works after being fed downhill from the storage tank that was located on the hillside above. Water was gravity fed by a flume from Chimacum Creek to the main part of the plant, and a historic lithograph shows what appears to be a flume coming downhill on the bluff at the head of the kiln area.¹⁶⁷ Water was sometimes sprayed on charcoal during the cooling down process. Also, charcoal, like coal dust, can ignite spontaneously and it seems unlikely that an operation involving a large supply of wood and other potentially flammable material would not have had some provision for fire suppression.

Service, U.S. Department of Interior), 1983 [WA-7-20]; Robert Teagle Private Collection. "View of charcoal kilns and iron plant from south end of beach, probably about 1901." Jefferson County Historical Society, Port Townsend, Washington, 1901, In Diane Britton and J. D. Britton, "Irondale Iron and Steel Plant." HAER No. WA-7. Historic American Engineering Record (HAER) (National Park Service, U.S. Department of Interior), 1983 [WA-7-24]; Unknown, Photo showing view from of upper deck of Irondale kilns looking southeast, ca. 1901-1902. *Seattle Daily Times*, August 20, 1950.

¹⁶² Cole H. Estep, "The Irondale Furnace Near Seattle, Wash," *Iron Trade Review* 41:4 (September 19, 1907.):466

¹⁶³ Anonymous, "Iron Making on the Pacific Coast," *Scientific American* 84 (December 21, 1901): 410.

¹⁶⁴ Clapp, 137-138.

¹⁶⁵ Estep, 466.

¹⁶⁶ *Ibid.*, 464.

¹⁶⁷ Unknown. Lithograph of Irondale Plant. *West Shore* (May 1885). Negative No. UW13083. University of Washington Libraries Special Collection Division. University of Washington, Seattle, Washington.

Firing and Operations

The 1901 photo that depicts the loading arrangement in the kiln shows that wood on the bottom layer has been stacked to create a hollow center trough beneath the stack where a torch could be inserted to fire the load.¹⁶⁸ Once kilns were loaded and fired, the upper and lower doors were closed and braced shut. It was customary to seal kiln doors with mud or clay to create a tight seal to control draughts and to reinforce the closure with an iron brace or plate.¹⁶⁹ Weather conditions as well as the relative dryness of the wood could affect the rate of burning. Experienced workmen with a good understanding of the firing process managed the burn by alternately stopping up and unstopping the vents near the lower door with firebrick in conjunction with operation of the damper, or explosion door that functioned to release steam at the top of the kiln during the reduction process.¹⁷⁰ Colliers, as charcoal workman were called, knew from the color of the steam or smoke what stage the carbonization process had reached.¹⁷¹

Time for production of charcoal varied but generally took place over seven to twelve days.¹⁷² A cool down period followed, with all vents gradually unstopped and the explosion door fully released to ensure that all reduction of the wood had ceased before the kilns were opened. A figure for early days of production at the plant estimated seventy-five cords of wood produced about 4200 bushels or about fifty-six bushels per cord.¹⁷³ Optimal yields depended on the large size and straight grain in the wood as well as the efficiency of the burning process and the considerable skill of an experienced collier.

Wood Supply to Furnace and Charcoal Warehouse

Finished charcoal was removed from the kiln through the lower door. Prior to the 1901 renovations, charcoal was unloaded from the kilns into hand carts and wheeled through the plant yard to its destination. During some periods of furnace operation, charcoal demand for the furnace would have been immediate, and finished product was brought by cart to the foot of the elevator house to be conveyed to the upper story where it was mixed in a crusher with portions of iron and ground lime. From there it was shoveled into charging barrows and run on

¹⁶⁸ Estep, 464.

¹⁶⁹ Gard, 22

¹⁷⁰ Ibid, 14; Asahel Curtis. Western Steel Corporation Iron smelting works, showing charcoal kilns, Irondale, Washington, ca. 1901-1902. Catalog ID Number 1943.42.426. Washington State Historical Society Collection, Tacoma, Washington. Washington State Historical Society Research – Collections Catalog: <http://collections.washingtonhistory.org/>; Unknown. Charcoal kilns at Irondale, ca. 1902. Washington, Order No. WAS150, University of Washington Special Collections Division, Washington Localities Collection. University of Washington Libraries, Seattle, Washington; Unknown, 1950.

¹⁷¹ Gard, 14; Egleston, T., "The Manufacture of Charcoal in Kilns,: Extracts of a paper read before the American Institute of Mining Engineers, *Journal of the United States Association of Charcoal Iron Workers* 2:1 (January 1881):56.

¹⁷² Estep, 466.

¹⁷³ Anonymous, "Irondale Furnace, Washington," *Journal of the United States Association of Iron Charcoal Workers* 9:1 (January 1891):25.

to large hoisting cages to be hauled to the top of the blast furnace.¹⁷⁴ Charcoal could also be stored in the warehouse located on pilings east of the kiln area.

After the 1901 improvements, a mechanical conveyance system moved the charcoal to the elevator house. Part of the 1901 improvements included a system of tramways throughout the yard for movement of supplies and finished products.¹⁷⁵ Two tracks shown on the historic diagram linking the head of the wharf in front of the plant to an area in front of the charcoal storage warehouse were probably used by a trolley and tramway system prior to the advent of the narrow gauge rail spurs that later circled the plant when it was being converted to steel production.

PART II ARCHITECTURAL INFORMATION

A. General Statement and Condition

During the Irondale cleanup project, after contaminated sediments and slag were removed from the inside and outside of the exposed portions of the western row of kilns foundations, the bricks were cleaned, and the structures were covered with protective geotextile, then buried in 1-2' of sand and topsoil. To help stabilize soils, a row of logs was buried in front of them and sparse planting was placed over the central area of each kiln. Kiln structures along the southwest portion of project that had been exposed by erosion were removed in pieces (formed by natural breakage) prior to the remediation project to facilitate removal of contaminated sediments from that area of the shoreline. Clean fill was added to replace some of the removed sediments and the structures were put back in place, remaining exposed as they had been prior to the project. The portions of other kiln foundations were cleaned as they were exposed and then reburied.

The kiln foundations were found to be in varying states of preservation when investigated in 2012. The better preserved structures retained all or part of their interior mortar surface. The 100-year old brick and mortar was found to be in friable and disintegrating condition, particularly near the surface where ground disturbance has been more prevalent and on those structures that had been exposed by erosion on the eastern row. The condition of the kiln foundation boards varied from thinning and deteriorated to no longer present. The segment of timber walkway exposed between the two rows of kilns during the cleanup project was removed following documentation due to contamination of the wood.

Piles of dense brick debris and fragments of kiln foundations found at the expected location of the two northernmost kilns indicate that these two structures were completely demolished, probably in 1910 when the kiln area was leveled to provide more room for waterfront storage

¹⁷⁴ Britton, 63; Anonymous, 1891: 26.

¹⁷⁵ Britton, 63.

and staging for planned steel production at the plant.¹⁷⁶ The southernmost kiln in the western row was outside the project area and was not investigated.¹⁷⁷

Parts of the timber bulkhead structure that held the artificial landform on which the eastern row and portions of the western row of kilns were originally built has disintegrated or washed away over the years, leading to loss of the sand and gravel fills. Remaining sections of the bulkhead structure were removed during the cleanup project as they were contaminated. Erosion continues to affect the eastern row of kiln foundations which are lagging onto the beach surface and subject to continued break-up as the mortar and brick disintegrates.

B. Description

Kiln Location and Layout

The charcoal kilns were constructed south of plant's blast furnace and elevator building in the area between the base of the bluff along the west side of the plant and the bulkhead on the east (water) side. Twenty beehive kilns were placed in a general alignment of two parallel northwest-southeast trending rows, with each kiln spaced approximately seven feet from the neighboring kilns. The western row comprised nine kilns situated along the base of the bluff. The eastern row of nine kilns was situated parallel to the bulkhead leaving enough space for a roadway or path between the kilns and the shoreline of Port Townsend Bay. A historic diagram shows two additional kilns were located slightly northwest of the western row.¹⁷⁸

The eastern row of kilns and part of the western row were constructed on an artificial platform composed of fine-coarse sand and gravels, probably dredged materials. The western row primarily rested just above native sediments. The extensive artificial landform was formerly held in place by the large timber bulkhead that was extended along the shoreline side of the plant.¹⁷⁹

Historic photos show the kilns and associated structures, including a planked wooden walkway forming a center aisle between the two rows of kilns, with a second level walkway supported on upright timbers.¹⁸⁰ At the north end, the walkway jogged slightly to the west to run along the west side of the two northern-most kilns. The walkway along the outside of the eastern row, was a dirt track parallel to the bulkhead that served as a wharf for anchoring scows that brought

¹⁷⁶ Michael Shong, Yonara Carrilho and Christian J. Miss, *Results of Cultural Resources Monitoring for the Irondale Iron and Steel Plant (45JE358) Historic District (DT 128) Remediation and Restoration Project, Jefferson County, Washington* (Seattle, Washington: Northwest Archaeological Associates, Inc. /SWCA Environmental Consultants, 2014).

¹⁷⁷ *Ibid*, 8.

¹⁷⁸ *Anonymous*, "The Inauguration of Steel-Making on the Pacific Coast," *Iron Trade Review* 45 (August 19, 1909):334.

¹⁷⁹ Shong et al., 22.

¹⁸⁰ Curtis, 1901; Curtis, ca. 1901-1902; Unknown, ca. 1902; Asahel Curtis. Pacific Steel Co., east side of plant from wharf showing casting house and beehive charcoal ovens, Irondale, Order Number CUR82, Asahel Curtis Collection, University of Washington Libraries Manuscripts, Special Collections, 1901, In Diane Britton and J. D. Britton, "Irondale Iron and Steel Plant." HAER No. WA-7. Historic American Engineering Record (National Park Service, U.S. Department of Interior), 1983 [WA-7-21].

timber to unload at the kilns. An associated log boom off of the southern portion of the kiln area served as a storage area for logs.

As seen in the photos, a second level of the walkway was supported by pairs of upright timber posts connected at intervals along the central walkway. The knee braces on the upright timbers supported upper beams on which the upper surface decking rested. Perpendicular to the main second level walkway, extensions were constructed between every set of two kilns to provide access to the upper doors, which were oriented toward one another.

Kiln Construction

The Irondale charcoal production area was built between the bluff and bulkhead in an area approximately 85' wide and 365' long, or a total area of approximately 28,945 square feet (.664 acres). Within this area, the circular foundation remains are spaced 7 to 8' feet apart from neighboring kilns. Each kiln was constructed in a design that narrowed in a geometric increase from an approximately 30' diameter base upward to a height of 30' to form a parabolic beehive. The kiln structure consisted of a brick core that was covered with concrete mortar and reinforced in several places along its height with iron bands. In most instances the foundation base was constructed of 3" x 12" inch boards approximately 4' long that had been laid side by side in a radiating pattern. The charcoal-blackened floor measured 1"-2" thick and rested directly on the interior sand fill.¹⁸¹

All seventeen of the documented structures are nearly identical in size and construction with only minor variations noted in brick configuration. The foundations were all approximately two feet in height, with an outside diameter that measured approximately 32'-6", with an inside diameter of 29'. The foundations retain three tiers of brick construction, with the bottom tier measuring approximately 2' wide and the top tier approximately 1'-6" wide.¹⁸²

The kiln profile shows courses of brick staggered horizontally, with the penultimate course set upright and the uppermost course horizontal. The plan view shows an inside and outside layer of brick laid horizontally on the long side, sandwiched around an inner layer of bricks turned at an angle perpendicular to outside rows (predominant pattern); or alternating one brick across, two sideways, one across, etc. between outside rows (occasional pattern).¹⁸³

As seen in historic photos, each kiln had a removable lower and upper cast iron door. Adjacent pairs of door on the lower level western row faced each other across the extensions of the central walkway and those in the eastern row faced outward to the wharf side.¹⁸⁴ Upper doors were somewhat smaller than those on the lower level, with each adjacent set of two facing one another on the lateral extensions of the walkway to share access from the upper level central walkway or the wharf.¹⁸⁵

A four inch high, flattish cast iron ring, found in excavation of one of the kiln foundations, had an outside diameter of 18", and an inside diameter of 14". From the size, shape, and construction

¹⁸¹ Shong et al., 26.

¹⁸² Ibid., 29.

¹⁸³ Ibid., 30.

¹⁸⁴ Curtis, 1901; Unknown, 1950; Curtis, 1901-1902; Unknown, ca. 1902

¹⁸⁵ Curtis, 1901; Unknown, ca. 1902; Unknown, Unknown, 1950.

of the ring, it appears to be the remains of one of the iron rings set into the top of the structure to hold the explosion door (damper) that released steam and smoke when the kiln was in operation. This type of structure can be seen at the top of the kilns in historic photos of the Irondale kilns.¹⁸⁶

The rows of vents in the lower portion of the kilns are also visible in historic photos where soot markings clearly show their locations.¹⁸⁷ They appear in three rows of alternating heights, the topmost one at a level about half way up the height of the lower kiln door and the lowermost at the height near the base of door. During firings, these vents would have been blocked with fire bricks that could be added and removed as needed to manipulate the air supply.

A segment of wooden walkway exposed between the two rows of kiln foundations measured approximately 4' x 5" wide. The walkway was constructed with 2" x 12" milled lumber planks measuring 12'-15' long. The planks were supported underneath by 4" x 6" cross beams spaced every six feet and secured with twenty penny wire nails. The cross beams were laid just below the surface of the sandy fill landform. A short run of planks connected the main walkway to the former entrance of one of the kilns. Similar kiln connections and extensions of the walkway between kilns were likely once present, although few were observed.

The foundation for the upper walkway, or catwalk, consisted of two one-foot square, 24' long lumber beams. The beams lay just under the surface of the sandy fill (historic surface) and positioned 1'-2' on either side of the walkway. Two additional catwalk foundation beams extended north under the concrete fuel tank, although the walkway in this area was not observed and may have been destroyed during fuel tank construction. Notches observed at the northern end of the beams show where upright lumber members once attached to support the catwalk structure.¹⁸⁸ In historic photos that the catwalk and upper conveyance structure are shown supported by a parallel row of timber posts reinforced with Y-shaped knee-braces, with posts running in parallel rows along each side of the catwalk structure.¹⁸⁹ No additional sections of the walkway were observed at the site.

A 2" diameter metal pipe was found buried beneath the central walkway and extended northwest/southeast the length of the site. Short sections of pipe branched off between two adjacent kilns and in the access area of a third, terminating in brass fitting, indicating a pressurized pipe that may represent a waterline. Alternately, it may have supplied air to facilitate the carbonization process. There is no indication that fuels other than wood and charcoal were used at the plant during the period when the kilns were constructed.

Other features recorded in the kiln area included remains of the timber bulkhead that formed a wharf on the water side of the kiln area, pilings in area where a charcoal warehouse was

¹⁸⁶ Robert Teagle Private Collection. "View of charcoal kilns and iron plant from south end of beach, probably about 1901." Jefferson County Historical Society, Port Townsend, Washington, 1901, In Diane Britton and J. D. Britton, "Irondale Iron and Steel Plant." HAER No. WA-7. Historic American Engineering Record (HAER) (National Park Service, U.S. Department of Interior), 1983 [WA-7-24]; Unknown, 1902.

¹⁸⁷ Curtis, 1901-1902.

¹⁸⁸ Shong et al., 31.

¹⁸⁹ Curtis, 1901; Teagle, ca. 1901.

situated perpendicular to the wharf on the east side of the kilns, and the remnants of a set of pilings at the south end of kiln area that may be related to with access structures.

PART III SOURCES OF INFORMATION

A. Architectural Drawings

No original architectural drawings for the Irondale kilns were located. Field drawings were made from photo documentation and measurements of the kiln foundations and portion of the lower walkway during 2012 archaeological monitoring of the Department of Ecology cleanup project. A combination of historical photographs, historic journal articles and a historical diagram showing a footprint of the kilns in relation to other project elements were consulted to describe the structures, their locations and relationship to other plant facilities, and information on operations.

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Museum of History and Industry, Seattle, Washington.
Washington State Historical Society, Tacoma, Washington.



Figure 1. Irondale Iron and Steel Plant Project location.



Figure 2. Location of Irondale Iron and Steel Plant features (45JE358).

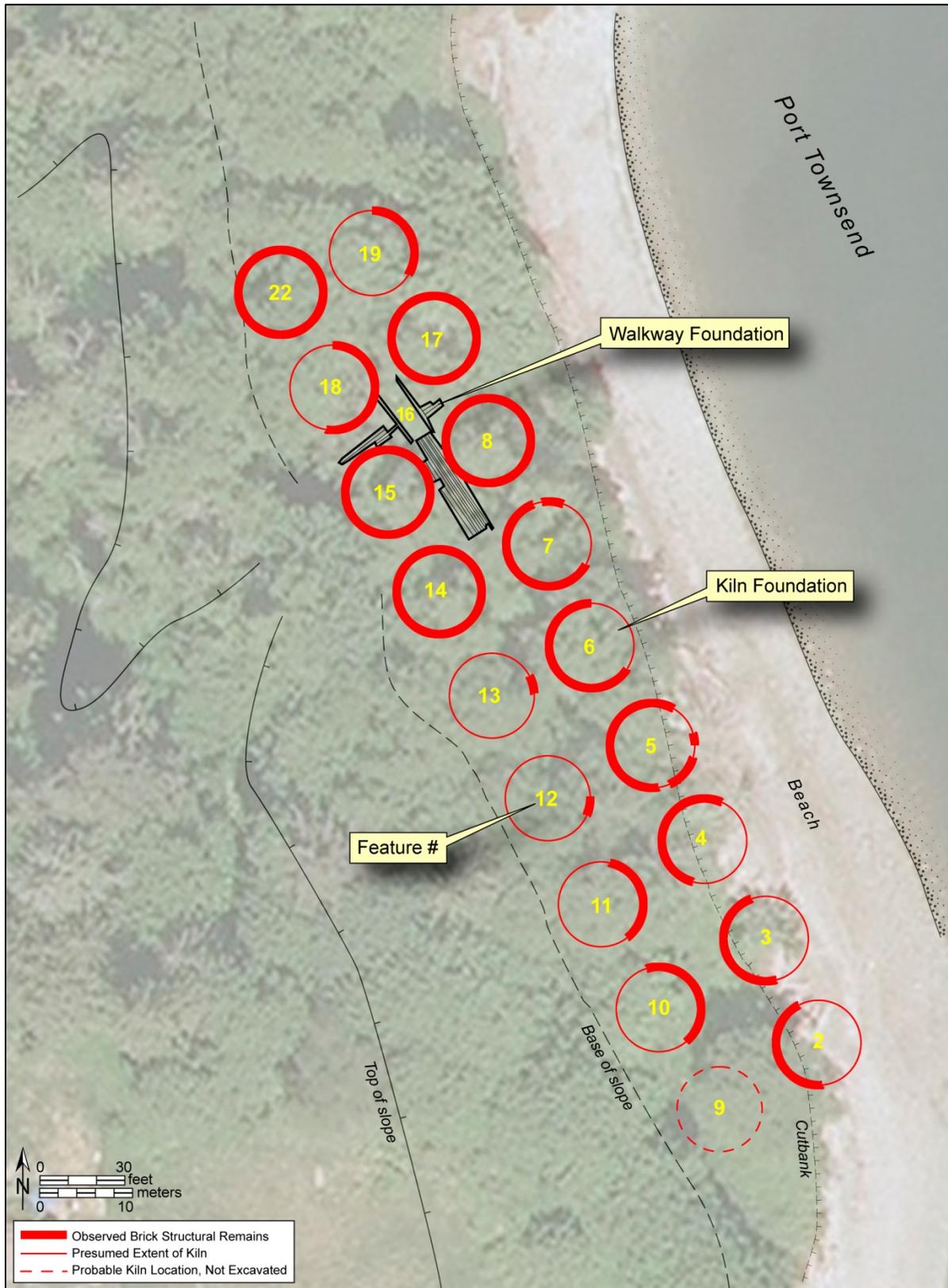


Figure 3. Irondale kilns and remains of central lumber walkway.

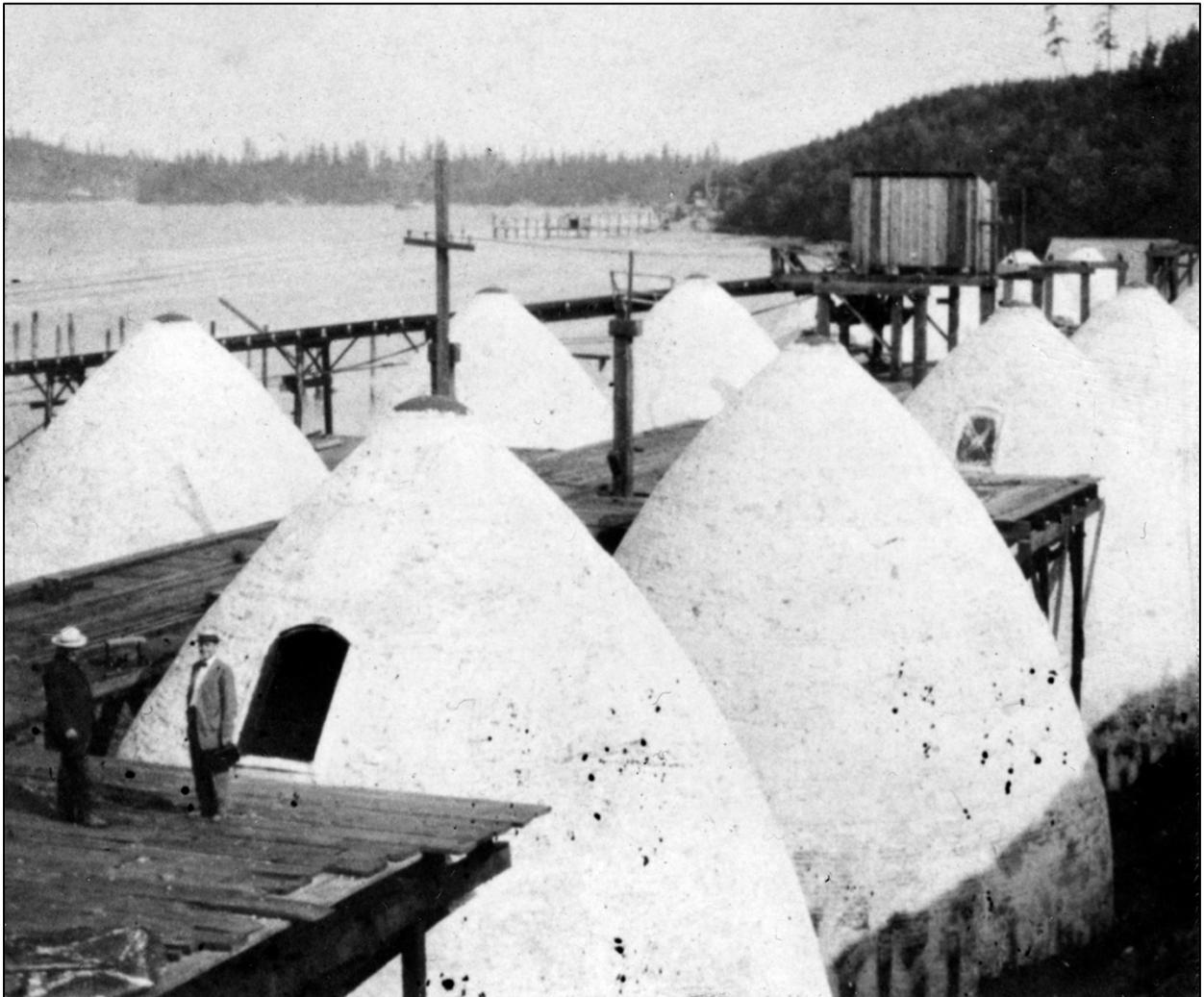


Figure 4. Historic photograph of charcoal kilns taken from catwalk, view southeast, ca. 1901-1902.
(Published in *Seattle Daily Times*, August 20, 1950).

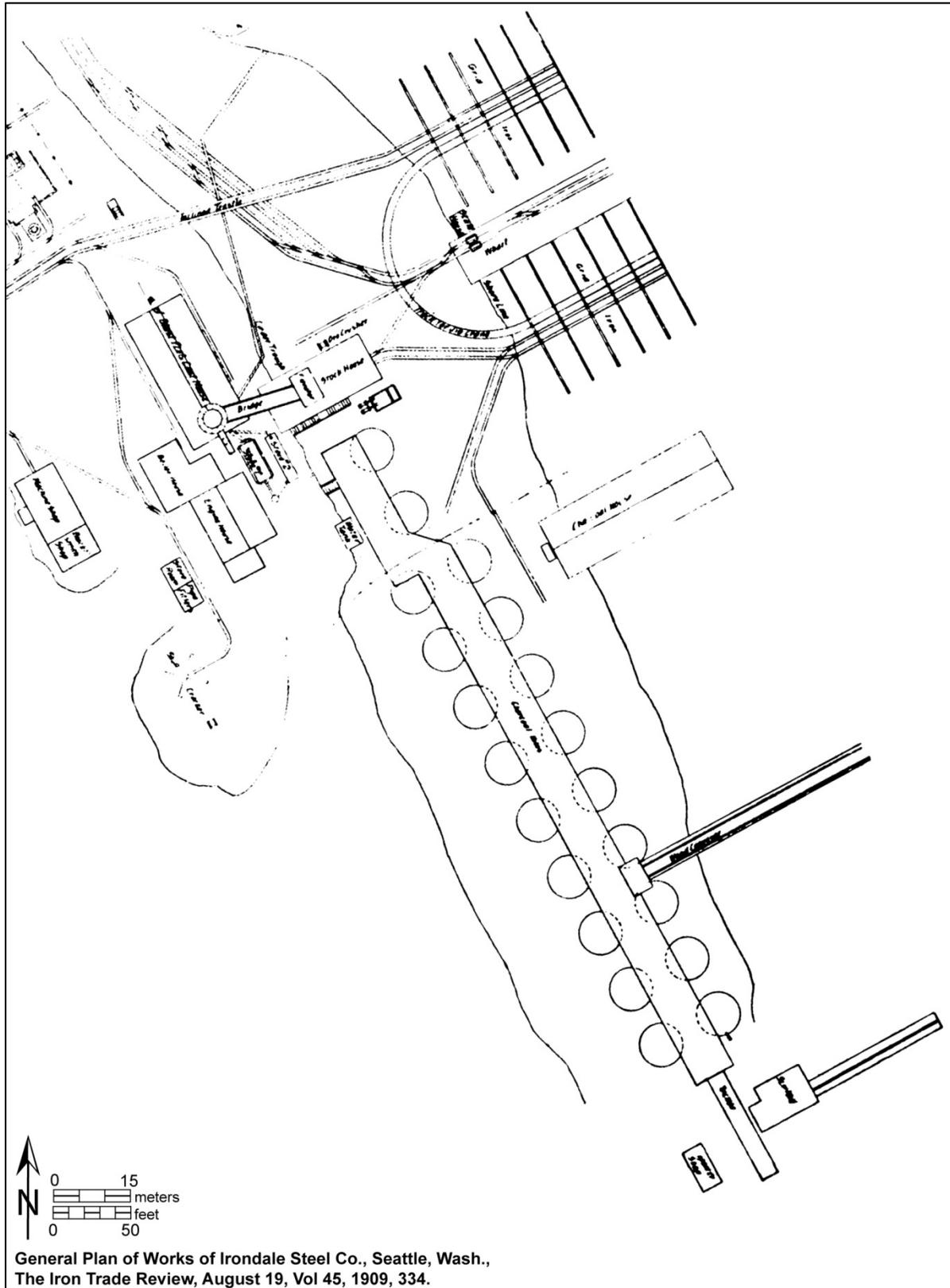


Figure 5. Historic plan of the Irondale Iron and Steel Plant.

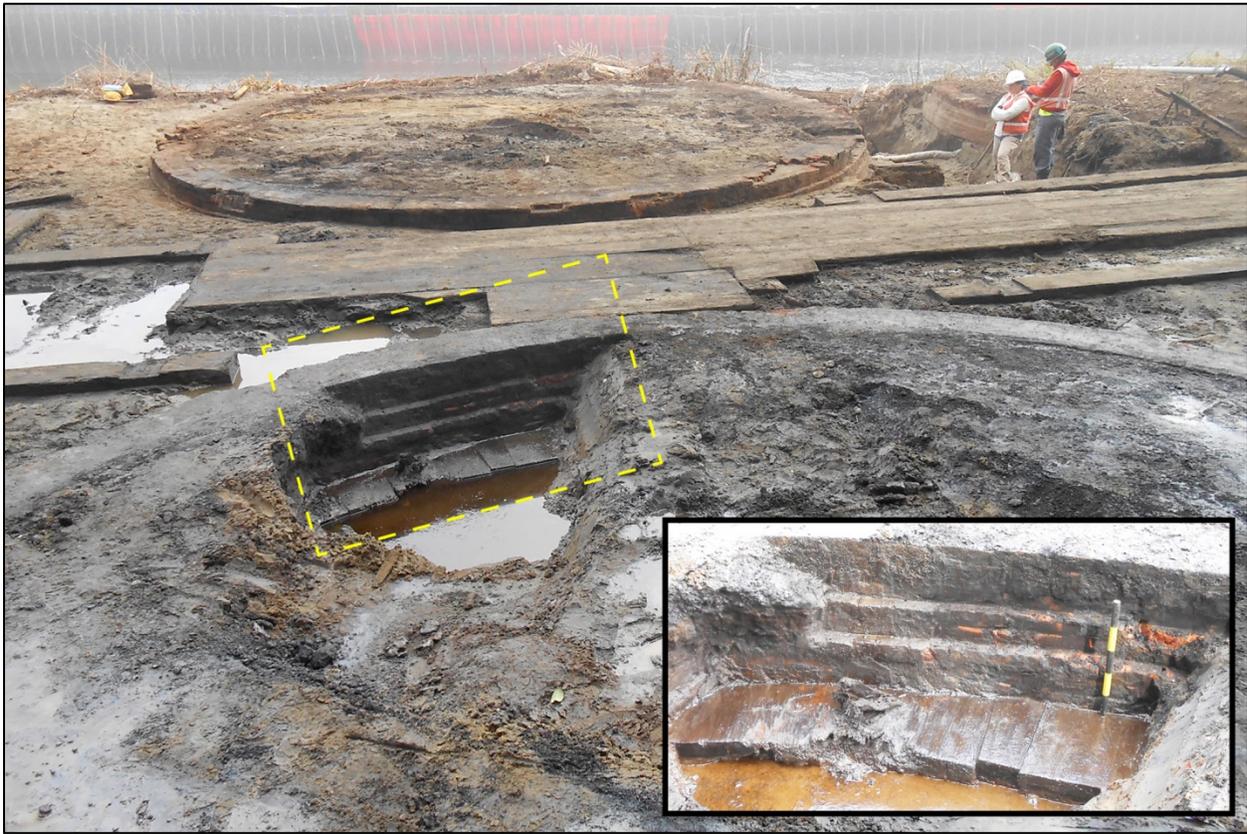


Figure 6. Overview of kiln foundations (F-15 in foreground and F-8 in background) showing milled lumber foundation remaining under some of the structures.



Figure 7. Overview of kiln foundation showing typical configuration of top course of bricks, view east.

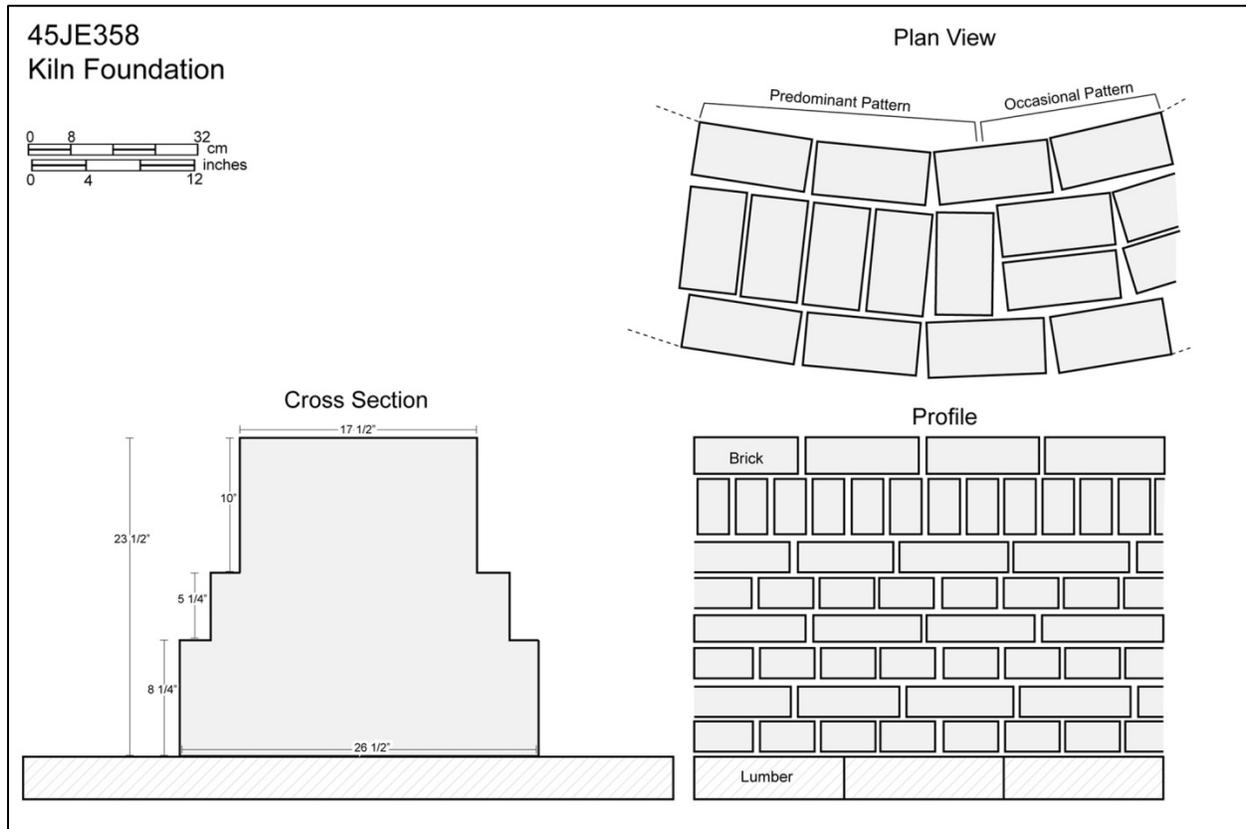


Figure 8. Schematic plan and profile of typical kiln foundation.



Figure 9. Remains of the explosion ring from top of a kiln.



Figure 10. Overview of lumber walkway and catwalk foundation, view southwest.



Figure 11. Close-up of lumber walkway; note plank extension leading to the former entrance of a kiln foundation, view northwest.